

Strategic Planning Background Document

Environmental Threats Assessment: Zambia

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October 9, 1997

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PART I. Introduction

1.1 Zambia in the Context of USAID's Environmental Policy and Priorities

USAID's *Environment Strategy* states that the wise use of natural resources and environmental protection are fundamental to USAID's assistance program. The strategy recognizes that concern for the environment and judicious management of the natural resource base are absolute requirements of any successful development program. Thus, USAID's *Strategies for Sustainable Development* (USAID 1994) provides explicit treatment of the environment as one of the five principal areas of current agency interest, together with building democracy, stabilizing world population growth, encouraging broad-based economic growth, and providing humanitarian assistance.

According to USAID's draft "*USAID Policy and Strategy for Biodiversity Conservation*," Southern Africa constitutes a key African biogeographic region. That document makes special reference to the wetlands of the Kafue River as a unique ecosystem within the region. Zambia, however, does not qualify as a "key" biodiversity country.

The *USAID Policy and Strategy for Biodiversity Conservation* further states that USAID will support biodiversity activities in at least one key country or regional program in each biogeographic region. Thus far, USAID's contribution to the conservation of biodiversity in Zambia has been provided through the regional Natural Resources Management Project funded through the Regional Center for Southern Africa (RCSA). This program comes to an end in 1999. A second phase is being designed, but it is unclear at this juncture how or if Zambia will be included.

Because of the importance placed on biodiversity conservation in particular, and environmental conservation in general, the Agency's *Guidelines for Strategic Planning*, states that a comprehensive environmental problems assessment must be conducted, in order to identify the actions necessary to achieve conservation of the natural resources base. According to the guidelines, CSPs submitted for approval in FY1995 and beyond, must be based on a comprehensive assessment of environmental threats and opportunities as they relate to the Agency's three country-level environmental objectives:

- **To safeguard the environmental underpinnings of broad-based economic growth;**

- **To protect the integrity of critical ecosystems; and**
- **To ameliorate and prevent environmental threats to public health.**

1.2 A Legal Requirement

The requirement that USAID country missions conduct environmental assessment of threats and opportunities has as its legal basis Sections 117, 118, 119 of the Foreign Assistance Act (FAA). Section 117 indicates that: "Special efforts shall be made to maintain and, where possible, restore the land, vegetation, water, wildlife, and other resources upon which depend economic growth and human well-being, especially of the poor." It also dictates that USAID take fully into account the impact of its activities on the environment and natural resources of developing countries. Section 118 requires that every country development strategy statement or country plan prepared by USAID include an analysis of: "1) the actions necessary in that country to achieve conservation and sustainable management of tropical forests, and 2) the extent to which the actions proposed for support by the agency meet the needs thus identified." Section 119 dictates that every country strategic plan developed by USAID shall include: "1) The actions necessary in that country to conserve biological diversity, and 2) The extent to which the actions proposed for support by the Agency meet the needs thus identified."

Further legal support for the inclusion of environmental assessments and prioritization in country strategic plans is provided by Section 496 of the FAA which establishes the Development Fund for Africa (DFA). Two of the DFA's priority areas are related to the environment: a) increasing agricultural production in ways that protect and restore the natural resource base; and b) maintaining and restoring the renewable natural resources base primarily in ways that increase agricultural production. The legal requirements of the FAA are reflected in USAID's 22 CFR Part 216 which codifies the Agency's procedures "to ensure that environmental factors and values are integrated into the USAID decision making process."

1.3 Purpose and Objectives of Desk-top Assessment

The purpose of this desk-top study was to review the condition of the Zambian environment to assist USAID/Zambia to identify priority strategic options in the environment. Of particular importance was the identification of the root causes of environmental problems. Addressing these root causes should be considered in the development of the operating unit's strategic plan.

The desk-top study pursued the following three objectives:

1. To evaluate the condition of the Zambian environment.
2. To identify and assess the severity of environmental problems from the standpoint of the three country-level environmental objectives.
3. To identify the root causes of the principal environmental problems as revealed by the review.

PART II. Methods

2.1 General Approach

Over the past few years, Zambia's environment and natural resource base have been the subject of several synthesis and reviews. Chief amongst them is the National Environmental Action Plan prepared by the Ministry of Environment and Natural Resources (MENR 1994). More recently, the International Union for Conservation of Nature (IUCN), in collaboration with the Ministry of Environment and Natural Resources, conducted a review of several environmental sub-sectors such as a situation analysis of land (Wilson 1996), wildlife (Chabwela 1996) and water resources (Nyumbu 1996). The IUCN study also examined the pertinent legal and institutional frameworks (Chinene et al. 1996), and assessed Zambia's environmental information and monitoring capacity. In 1995, Yachiyo Engineering (1995) developed the National Water Resources Master Plan, which contains important information on the situation of the country's water and fisheries resources. To these one may add many more documents produced by a number of actors in the environment, including USAID/Zambia, the World Wide Fund for Nature (WWF) and the Department of National Parks and Wildlife.

Because of the apparent existence of considerable information on Zambia's environment, USAID/Zambia decided that yet another study was unnecessary to meet the operating unit's strategic planning needs. It opted instead to synthesize the existing information and examine it through the prism of the Agency's strategic planning guidelines. Thus, save for new information derived from selected field visits by staff from USAID/Zambia, REDSO/ESA (Queiroz 1996, 1997; McCarthy 1997), and Missouri Botanical Gardens (Harder 1997) this assessment was based on a review of existing published material.

The above notwithstanding, the review of literature revealed a serious dearth of quantitative information concerning some aspects of E/NRM in Zambia. Many current documents utilize data

from studies conducted during the colonial period or soon after independence. For example, there has not been an assessment of the country's tree cover in over 30 years, nor is there socio-economic or anthropological studies that quantify the reliance of rural households on natural resources. The later is not only true of more obscure natural resources products, such as honey and wild foods, but also of fisheries resources, a key ingredient in the livelihood systems of most rural households. This lack of reliable up-to-date information subtends a literature that is qualitatively consistent but fraught with quantitative uncertainty.

2.2 Specific Steps Taken to Meet Objectives

Objective 1. To evaluate the condition of the Zambian environment.

The evaluation of the condition of the Zambian environment was accomplished primarily through a review of secondary sources. Two categories of documents were consulted: 1) GOZ and donor generated documents (e.g. National Environmental Action Plan) and consultant reports; and 2) documents generated by researchers and scientific organizations. These two types of publications differ in terms of the breadth and quality of the information. Government and consultant's reports offer a more general view of the situation, and present data already extracted from other sources; publications generated by researchers present original data, usually focusing on a specific topic. The first set was used to gain an understanding of the broad issues, the second set was used selectively as a check against which generalizations made in the first class of documents were verified.

Objective 2. To assess the severity of environmental and natural resources threats from the standpoint of the three country-level environmental objectives.

The current situation of Zambia's environment, as revealed by the activities under *Objective 1*, was juxtaposed against the three country-level environmental objectives. The severity of environmental problems was evaluated, whenever possible, in light of *The Key Factors in the Environment*, that according to the Guidelines for Strategic Plans (USAID 1995) must be considered in evaluating the importance of environmental and natural resources threats. Briefly, the key factors considered were:

- Losses in GDP due to natural resources depletion or pollution;
- Rate of degradation of critical ecosystems;
- Environmental health risks (e.g. water and air pollution);
- Degree of threat to undegraded resources that have economic, ecological and public health significance (e.g. standing forests, wetlands, coral reefs, watersheds, topsoil, surface waters);
- Public health and ecological implications of trends of urbanization, industrial development, and population/demographic changes;

- Priority given to strengthening environmental policies and programs by local partners, both governmental and non-governmental.

Because of the unreliable, incomplete, and outdated nature of quantitative environmental information in Zambia, I was unable to attach precise values to the consequences of environmental degradation. My assessment of the situation is often qualitative.

Objective 3. To identify the root causes of environmental problems.

The identification of root causes of environmental problems included consideration of natural resource management practices, socio-economic factors, and the institutional, policy, legal and regulatory framework that influence how people interact with the environment. This analytical exercise was based on the information generated by an extensive review of literature, supplemented by insights from several individuals interviewed during two visits to Zambia (Queiroz 1996, 1997; McCarthy 1997).

Part III Environmental Profile of Zambia

3.1 Geographic Setting and political sub-division

Zambia occupies 752,614 km² of the Southern African region. It sits between about 8°00' and 18°00' south latitude and 22°00' and 33°30' east longitude and borders Mozambique and Malawi to the east, Tanzania to the northeast, the Democratic Republic of Congo (DRC) to the north, Angola to the west, and Namibia and Zimbabwe to the south. Zambia's southern border intersects with those of three other countries -Zimbabwe, Botswana, and Namibia- at the eastern most tip of Namibia's Caprivi Strip.

Politically Zambia is sub-divided into nine large provinces. The Western and Northwestern Provinces occupy the western most third of the country; Luapula and Northern Provinces cover the northern fourth, the Eastern Province occupies an elongated swathe along its eastern border, and the Copperbelt, Central, Southern and Lusaka Provinces cover its mid-portion. These nine provinces are sub-divided into 49 districts. Additional administrative units include 3 city councils and nine municipal councils. When the 1990 census was conducted there were 92 "urban centers". Of these settlements, 10 had populations in excess of 50,000, 48 had populations between 5,000 and 50,000, and the remainder had populations smaller than 5,000.

3.2 Topography

Zambia sits on the Central African Plateau. South of 14° latitude, altitudes range from 900 to 1200 m, save for the Tonga Plateau near the border with Zimbabwe which sits between 1200 and 1500 m, and the low lying Lake Kariba environs. Above that latitude, altitudes are generally between 1200 m and 1500 m, with the exception of the low lying Luangwa valley situated between 300 m and 600 m. The largely rolling to slightly undulating topography is infrequently broken by hills and mountains, chief amongst them the Makutu Mountains near the border with Malawi, which exceed 2000 m in altitude.

3.3 Climate

Zambia is a relatively well-watered country. Within its western half, mean annual rainfall increases from 700 mm along the country's southern border with Namibia and Zimbabwe, to over 1500 mm along the northern border with the DRC. Within the northeastern half of the country, the rainfall gradient manifests itself from east to west. Thus, along the border with Malawi, mean annual rainfall range from 800 to 1000 mm, increasing to over 1500 mm over the highlands of Northern and Luapula Provinces near the DRC.

Throughout Zambia, rainfall distribution is unimodal. Ninety-percent of rainfall takes place in the wet season from November to April. Rainfall variability is greatest in the southernmost portions of the country where mean annual rainfall is least. For example, along the border with Namibia, average deviations from mean annual rainfall is between 25% and 30%; along the northern border with the DRC it is less than 15%.

The coldest months are June and July, when mean minimum monthly temperatures are between 5°C and 10°C in most of the country. The onset of the wet season -October/November- coincides with the warmest period of the year when mean maximum monthly temperatures equal or exceed 30°C.

Average annual rainfall, potential evapotranspiration and rainy days by province are presented in Table 3.1. Southern and Western Provinces emerge as the two driest provinces in the country followed by Lusaka and Central Provinces. Luapula and the Copperbelt are the two wettest Provinces in the country.

Droughts are most severe in Southern, Western, Eastern and Lusaka Provinces (Yachiyo Engineering 1995). This is because these are the driest provinces in the country. Nonetheless, Table 3.2 shows us that the well-watered provinces, such as Luapula, Northern, and Northwestern Provinces can expect substantially (25%) less rainfall than average once every five

years. This variation, coupled with the low soil-water holding capacity and low soil fertility, must pose a serious constraint to agricultural production in those provinces.

Table 3.1. Average rainfall, potential evapotranspiration, difference between rainfall and potential evapotranspiration, and days with rain in Zambia's nine provinces. Averages are values from all stations within provinces.

Province	Annual Rainfall (mm)	Potential evapo-transpiration (mm)	Rainfall (mm) minus evapo-transpiration	Days with rain
Lusaka	857	1571	-714	77
Copperbelt	1231	1530	-299	111
Central	947	1621	-674	86
N/Western	1173	1475	-302	118
Western	808	1705	-897	87
Southern	737	1669	-932	74
Luapula	1259	1508	-249	123
Northern	1138	1549	-411	107
Eastern	961	1531	-570	93
Total Average, Zambia	1001	1574	-573	97

Table 3.2. Expected minimum annual rainfall every five years at provincial capitals.

Province	Average rainfall at capital (mm)	Probable minimal rainfall every 5 years (mm)	Percentage of average
Lusaka	858	671	78%
Copperbelt	1205	956	79%
Central	886	725	81%
N/Western	1300	922	71%
Western	903	768	85%
Southern	979	597	60%
Luapula	1358	837	61%
Northern	1323	938	70%
Eastern	990	790	79%

Yachiyo Engineering (1995) undertook an analysis of long-term rainfall trends at provincial capitals. Their results are summarized in Table 3.3. It is clear that over the past 10 years Zambia has experienced a generalized drop in rainfall, the sole exception being Lusaka, perhaps due to alteration of the local climate by the utilization of ground water used to irrigate gardens and planted trees. This generalized declining trend is most pronounced in Central ($-5.8 \text{ mm year}^{-1}$), Western ($-4.1 \text{ mm year}^{-1}$), and the Copperbelt ($-4.0 \text{ mm year}^{-1}$), but most significant in Southern Province ($-3.0 \text{ mm year}^{-1}$) because of the already limiting average rainfall.

Table 3.3. Long-term rainfall trends in Zambia's Provincial capitals.

Province	Trend (mm) as indicated by linear regression coefficient	Average last 10 years (mm)	Average last 30 years (mm)
Lusaka	+1.8	842	857
Copperbelt	-4.0	1216	1231
Central	-5.8	911	947
N/western	-1.6	1153	1173
Western	-4.1	767	808
Southern	-3.0	687	737
Luapula	-2.6	1201	1259
Northern	-3.2	1121	1138
Eastern	-0.7	975	961
Zambia	-2.4	974	1001

3.4 Hydrology

Hydrologically, Zambia may be sub-divided into 6 major basins: The Zambezi main basin, the Kafue, Luangwa, Chambeshi, Luapula, and Lake Tanganyika (Table 3.4; adapted from Nyumbu, 1996).

The main Zambezi channel basin encompasses over 1/3 of Zambia's territory. If one adds to this the area within the Kafue and Luangwa basins, both major tributaries of the Zambezi, it becomes apparent that over 75% of Zambia's territory drains into that river.

Within these basins there are extensive wetlands of national and regional significance. Chief amongst them are the Barotse Flood plains along the Zambezi, the Kafue Flats, and the Bangweulu and Lukanga swamps. Important lakes include Lake Tanganyika, Lake Bangweulu, Lake Mweru-Wantipa and Lake Mweru. It is estimated that over 6% of the country's surface is covered by rivers, streams, lakes, and wetlands.

Table 3.4. Zambia's major watersheds.

River/Lake Basin	Length in Zambia	Basin Area (km ²)		
		Total	In Zambia	% in Zambia
Zambezi main channel	1,700	687,049	268,235	39
Kafue	1,300	156,995	156,995	100
Luangwa	850	147,622	144,358	98
Chambeshi	560	44,427	44,427	100
Luapula	615	173,396	113,323	65
L. Tanganyika	n/a	249,00	15,856	6
Other	n/a	no data	8,658	--
Total	5,275	1,458,489	751,852	n/a

Ground water is widespread throughout Zambia. Average minimum and maximum ground water level measured in shallow wells for Zambia's provinces are presented in Table 3.5.

Table 3.5. Minimum and maximum ground water-level measured in wells. Values were extracted from figures in Yachiyo Engineering (1995).

Province	Average minimum water level (m)	Average maximum water level (m)
Lusaka	5	7
Copperbelt	5	8
Central	5	8
N/Western	9	11
Western	3	6

Southern	8	11
Luapula	6	9
Northern	10	12
Eastern	5	8

Ground water level of shallow wells is generally found within 10 meters in most areas in Zambia. The minimum depth ranges from 5 meters (Lusaka, Copperbelt, Central, Eastern) to 10 meters (Northern). The differences between minimum depth (April) and maximum depth (October) is between 2 and 3 meters.

3.5 Soils

The western quarter of the country is dominated by the Arenosol, Gleysol and Podzol soil groups (GOZ 1986). The first of these encompasses infertile soils with low water holding capacity, soils in the second group pose problems due to periodic water logging, and the third group is characterized by soils with an acid and bleached surface horizon (FAO/UNESCO 1988). The Gleysols, which do have moderate agronomic potential for paddy rice cultivation and support key dry season grazing, are concentrated within floodplains of the Zambezi and other major rivers.

The eastern portion of Northwestern Province, and large areas of Central, Copperbelt Northern and Southern Provinces are underlain by acid and infertile Ferrasols and Acrisols. Large swaths of shallow Litosols traverse the country from southeast to northeast. Dark-cracking Vertisols, generally fertile but poorly drained and physically difficult to manage, occupy the Kafue flats and significant areas within Southern Province. The Luangwa Valley is covered by Vertisols and often fertile but flood-prone alluvial soils known as Fluvisols .

The proportion of Zambia's surface suitable for agriculture is subject to debate. For example, Lichtel et. al. (1992) present data indicating that of the total 75 million hectares, around 40 million are deemed suitable for agricultural use. Of these, nine million are classified as having reasonable potential for arable agriculture. Nyumbu (1996) state that about 16 million hectares are classified as "agricultural land" but forgets to define this category.

The Water Master Plan (Yachiyo Engineering 1995), paints a complete but rather convoluted picture. Their analysis is based on original data and merits serious consideration.

According to that document 80% of Zambia's surface is classified as "suitable¹" for cultivation. However, the document states that this figure includes Ferrasols, Acrisols, and Arenosols, three

dominant soil units in Zambia with have characteristics that seriously compromise their suitability for crop production. According to data presented in the Water Master plan, 78% percent of the land surface (40.4 million hectares) classified as suitable for cultivation is actually occupied by very strongly acid soils (Ferralsols, Acrisols), or soils that are infertile and excessively drained (Arenosols). A break-down of the distribution of these acid and excessively drained soils by Province is given in Table 3.6.

Sixty-six percent of Luapula Province, 64% of Northern Province and, 35% of Northwestern Province is covered by very acid Ferralsols and Acrisols. Excessively drained and infertile Arenosols cover 79% of Western Province and additional 34% of Northwestern Province. These three (Ferralsols, Acrisols, Arenosols) soil units cover 56% of the remaining five (Copperbelt, Lusaka, Eastern, Central, and Southern) provinces.

Table 3.6. Acreage and percentage of land surface occupied by soils with serious limitations for cultivations (Unit: 1,000 ha).

Province	Acrisol	Ferralsol	Arenosol	Other Unsuitable	Total area with limitation (000's ha)
Luapula	2,898 65%	23 1%	104 2%	1,131 25%	4,156 93%
Northern	8,251 57%	1,045 7%	599 4%	2,051 14%	11,946 83%
N/Western	1,699 14%	2,641 21%	4,224 34%	1,497 11%	10061 80%
Western	731 6%	0 0%	10,121 79%	485 4%	11,337 89%
Other Provinces	6041 20%	516 2%	1309 4%	12,745 42%	20,611 61%
Zambia	19,620 26%	4225 6%	16357 22%	17,909 24%	58,111 78%

What the data presented in the Water Master Plan show, is that only 8.8 million hectares, or 11% of Zambia's surface offer opportunity for viable market-oriented agriculture in Zambia's current

infrastructural and economic context. Fertile areas are concentrated in Lusaka Province, Eastern Province, patches in Northwestern Province, Central Province, and the northern portions of Southern Province. These areas are typically underlain by Luvisols, Cambisols Lixisols or Phaeozems, four categories of soil with moderate to good agronomic aptitude. In the foreseeable future, the remaining 89% of the country's surface will continue to be used for grazing, wildlife, forestry and small-scale farmers utilizing time-tested shifting cultivation, or variations thereof such as improved fallows.

The findings in the Water Master Plan are corroborated by Mackel (1971) who states that only 20% of the country's surface is covered by soils with moderate inherent fertility, with the remainder dominated by soils of low fertility, and Roberts and Elliot (1971) who estimate that only 10% of the country's surface is suitable for maize production without major constraint.

3.6 Vegetation

Over 69% of Zambia's surface is covered by woodlands, found in every province within the country. These include open canopy *Kalahari Woodlands* dominated by *Guibourtia spp.*, *Burkea spp.* and *Erythrophleum spp.*, seasonal Miombo, and closed-canopy wet Miombo, both dominated by *Brachystegia spp.*, *Burkea spp.*, *Isoberlinia spp.* *Julbernardia spp.* and *Pterocarpus spp.* (Table 3.7). Evergreen forests, typified by *Parinari spp.*, and *Syzygium spp.*, cover around 12% of the country and are concentrated in Luapula and Northern Province, with significant patches also in Western and Northwestern Provinces. Bushland and thickets, occupying over 7% of the country, occur primarily in the Luangwa Valley. Other vegetation types with restricted occurrence include *Colophospermum mopane*/*Acacia* wooded grasslands, distributed in patches primarily in Western Province, and mosaics of cultivated land intermingled with forests or woodlands. Zambia's vegetation cover includes over 5500 species of flowering plants, 88 species of mosses, and 146 species of ferns (Chisumpa 1990, Phiri and Ochyra 1988, Kornas, 1979).

In addition to these major vegetation types, the vegetation found on the Mafinga Hills and Makutu mountains in Isoka District on the border with Malawi's Nyika National Park deserve special mention. The vegetation cover in those areas consists of montane and sub-montane forests, scrubland and grasslands. Fanshawe (undated memo) in a reconnaissance survey found a total of 107 species endemic to the Nyika plateau and surrounding highlands.

Table 3.7. Principal vegetation types in Zambia (Source: Millington et al. 1994).

Vegetation Type	Typical Species	Rainfall Belt (mm)	Area (km ²)	% of Country
Seasonal Miombo woodlands	<i>Brachystegia spp.</i> , <i>Burkea spp.</i> , <i>Isoberlinia spp.</i> <i>Julbernardia spp.</i> and <i>Pterocarpus spp.</i>	800-1200	344,891	46.2
Wet Miombo woodlands	Same as above	1100-1500	102,967	13.8
Kalahari woodlands	<i>Guibourtia spp.</i> , <i>Burkea spp.</i> and <i>Erythrophleum spp.</i>	600-800	72,561	9.7
Evergreen forests	<i>Parinari spp.</i> , and <i>Syzygium spp.</i>	1200+	86,420	11.56
Bushland and thickets	<i>Acacia spp.</i> , <i>Commiphora spp.</i>	900-1100	55,067	7.4
Wooded grasslands/Mopane woodlands	<i>Colophospermum mopane</i> , <i>Acacia spp.</i>	700-1100 (estimated)	25,294	3.4
Mosaic, Cultivation-Woodlands and forests	Varied	wide range	35,253	3.9

3.7 Population and Economy

Zambia is host to around 10 million inhabitants, distributed between 73 ethnic groups (The Economist Intelligence Unit 1996). Of these, 42% (MENR 1994) live in urban areas, making Zambia the most urbanized country in sub-saharan Africa.

The population growth rate dropped from 3.1% between 1970 and 1980 to 2.7% between 1980

and 1990 (Yachiyo Engineering 1995). The highest population densities are found in Lusaka, Southern, Eastern, and Copperbelt provinces. In addition to Lusaka, the mining districts of Ndola, Luanshya, Kitwe, Mufulira, Kalulushi and Chingola in the Copperbelt, and Kabwe in Central Province have population densities higher than 100 km⁻². While the rate of migration to urban centers has declined over the past decade, it is expected to increase once the economy in urban areas recovers.

Considerable confusion exists as to the relative contribution of the different sectors to the national economy. The figures provided herein are only indicative. Manufacturing, including the processing of agricultural and non-mineral natural resource products, is the most important sector of Zambia's formal economy, contributing to over 25% of GDP. Agriculture, forestry and fishing are the primary source of livelihood to over 50% of the population, (of which over 90% are small scale producers) (MENR 1994), and contribute 18% to Zambia's GDP (The Economist Intelligence Unit 1996). Trade, hotels, and restaurants, a sector of the economy closely linked with tourism, accounts for 11.7% of the country's GDP. Mining, once the backbone of the country's economy, now contributes only 6% to GDP, but remains the greatest generator of government revenue and source of foreign exchange (MENR 1994). The formal sector accounts for only 13.7% of employment and unemployment is estimated at 30%.

On the average, 70% of household income is spent on food. This figure reflects the level of widespread poverty in Zambia, where an estimated 40% of all children are chronically undernourished (MENR 1994).

3.8 Land-Use and Renewable Resource Utilization

3.8.1 Agriculture

Maize is the main crop for both cash and food. It accounts for over 50% of cultivated area. Important food crops include cassava, sorghum, millet, and sweet potato. Other principal cash crops are wheat, soybeans, sunflower, groundnut, tobacco, vegetables, coffee, cut flowers and tea. Fourteen and a half percent of farming households produce only crops, whereas 80% produce crops in conjunction with either poultry, livestock or both. Only 0.6% kept only livestock (National Census of Agriculture, 1990/1992).

In 1990, there were over 520,000 farming households (National Census of Agriculture, 1990/1992; Table 3.8). Small-scale farms, defined as production systems utilizing low input technology (hand hoe or ox cultivation) and producing primarily for home consumption, constituted over 92% of farming households. On the average each farming household cultivated

2.2 hectares for a total of 1.1 million hectares.

Eastern, Southern and Central Provinces had the largest area under cultivation, whereas the largest per capita cultivated areas were found in Southern and Central Provinces, where the medium and large scale farms are concentrated.

Table 3.8 Are planted, farming households, and cultivated area per household in Zambia's nine provinces.

Province	Area Planted (1990)	Farming Households (1990)	Cultivated area per household (1990)
Lusaka	39,082	13,305	2.94
Copperbelt	39,123	24,108	1.62
Central	165,844	49,683	3.34
N/Western	31,847	39,788	0.8
Western	65,916	47,951	1.37
Southern	332,459	57,491	5.78
Luapula	43,026	68,206	0.63
Northern	102,554	88,186	1.16
Eastern	334,049	131,802	2.53
Total	1,153,900	520,520	2.22

Livestock production is dominated by cattle. National cattle herd size estimates range from around 2.2 (MENR 1994) to 2.7 million (Yachiyo Engineering 1995) head. In 1990, the national sheep and goat flock consisted of 592,000 head, and the number of pigs was 303,000. In that year a total of 7.9 million poultry were bred in the country (Yachiyo Engineering 1995).

Cattle population is concentrated in the drier regions of the country. In 1990, 39% of the national herd was present in Southern Province, 20% in Western Province, and 19% in Central and Eastern Province. The largest percentages of sheep and goats are found in Southern (46%) and

Eastern (27%) Provinces. Eighty-two percent of the cattle herd and 93% of the small-ruminant flock are kept by traditional producers.

It is estimated that around 40% of the national cattle herd concentrates in the Kafue Flats during the dry season (Lichte et al. 1992). East coast fever, contagious bovine pleuropneumonia, and trypanosomiasis are significant constraints to cattle production.

3.8.2 Fisheries

Officially, fisheries contributes 1.2% to GDP². This is certain to be a gross underestimation of the contribution of this sector to GDP, as a large portion of transactions involving fisheries resources take place outside the formal economy. Given the dispersed nature of Zambia's fisheries, it is also likely that a significant proportion of the annual fish catch from small streams, lakes, and wetlands go undetected.

An estimated 300,000 household have fisheries as their primary source of sustenance, and an estimated 40% (8.6 Kg per capita per annum) of animal protein consumed by humans in Zambia is derived from the fisheries sector. Of the estimated 70,000 tons of fish produced annually in Zambia only 3.5 tons are attributed to aquaculture, the remainder coming from natural fisheries. The major fisheries are Lake Tanganyika, Lake Kariba, Lake Bangweulu and surrounding wetlands, Lake Mweru, Lake Mweru-Wantipa, the Luapula River, the Kafue River and Flats, the Barotse Flood Plains, and the Zambezi River.

3.8.3 Forestry

As indicated above, the bulk of Zambia is covered by forests and woodlands. Official figures put the contribution of the forestry sector to GDP between 0.9 (MENR 1997) and 3%³. These figures are likely to be gross underestimates of the contribution of forest resources to Zambia's economy, because the bulk of transactions involving forestry resources go undetected by official accounting mechanisms (MENR 1997). In fact, woodfuel from the country's forests and

woodlands accounts for 71% of the nation's energy consumption, and 96% of household energy consumption (MENR 1997). Legally and illegally extracted wood provides poles for construction, fencing, curios, mine shaft support, railway ties etc.

In vast areas of the country, forest-based beekeeping is the principal source of livelihood. For example, data from the main producing areas in North Western Province, which covers Solwezi, Kasempa and Mwinilunga districts, indicate that 6,000 beekeepers using about 500,000 beehives produce over 600 tons of honey and 100 tons of wax per year (MENR 1997). At the national level it is estimated (MENR 1997) that national honey production is around 1500 tons per year.

Total sawmilling capacity in the country is estimated at 366,500 m³ per year (MENR 1997). Fifty-seven percent of sawmill production is met from natural forests, and the remainder from forest plantations. Other uses of forest products include medicinal plants, caterpillars, fruits, and fibers, mushrooms, tubers, insects, game meat, gums, resins, and dyes.

PART IV. ENVIRONMENTAL THREATS

4.1 Affected Resources and Scope of Report

Zambia's National Environmental Action Plan (NEAP) identified water pollution, soil degradation, air pollution in the Copperbelt, wildlife depletion, and deforestation, as the five environmental issues with the greatest social cost. In this report we deal with a slightly different set of topics for two reasons. First, in-country investigations (Queiroz 1996, 1997; McCarthy 1997) and the desk-top study revealed other environmental threats to Zambia's sustainable development. Second, because this threats assessment was conducted to assist USAID/Zambia to develop its strategic plan, I assessed the country's environmental situation through that operating unit's and USAID's prisms. There is no indication from the mission that urban and mining related environmental issues will be considered as strategic alternatives. Thus, these issues are not dealt with in this report.

4.2 The Situation of Wetlands, Lakes, and Rivers

4.2.1 Water quantity and quality

Zambia is well endowed with water resources. Over 6% of the country's surface is occupied by rivers, lakes, or wetlands. According to the National Water Resources Master Plan (Yachiyo Engineering 1995) current water consumption amounts to less than 2% of available water

resources, and less than 3% of surface water resources (Table 4.1). Projections made through 2015 indicate that total consumption will increase to 4% of total resources and 7% of surface resources. Thus, in terms of water availability at the national level, Zambia has little to worry about.

At the national level, the situation with respect to water quality is also favorable. A detailed study undertaken by JICA (Yachiyo Engineering 1995) showed that water quality in Zambia's major rivers is good to excellent. Some areas of concern include high copper concentrations and nutrient loads that are nearing unacceptable levels in selected watersheds. Calculations of the effects of increasing extraction to meet projected 2015 water demands also indicate that, provided adequate measures are taken to control pollution, reduced flow levels will not result in a significant deterioration of water quality.

Table 4.1 Water resources and consumption in Zambia (1994). Source; The National Water Master Plan.

Resources	m ³ /sec	Water use and losses	m ³ /sec
Surface flows	3100	Urban/Industry	15
Groundwater	1480		
		Agriculture	75
		Flow to other countries	2735
		Losses from rivers	60
		Evaporation from storage	260
		Evapotranspiration from ground water	1460
Total	4580	Total	4580

The favorable national level situation changes once the focus shifts from national averages to the Kafue basin, perhaps the most important river in Zambia. It provides water for mining operations, culinary use, irrigation, wildlife, and hydroelectricity, not to mention the environmental services and the importance of its fisheries.

In terms of water quality, the Kafue river is in less than ideal condition; the upper Kafue experiences high levels of turbidity and the lower Kafue low levels of dissolved oxygen; copper and nitrate levels tend to approach the limits of acceptable standards (Yachiyo Engineering 1995). All other parameters were well within the limits of stringent environmental standards.

Whereas the data and future plans for the Kafue are unclear, future water demand pose a significant threat to the River, a major tributary of the Zambezi River. The Kafue Basin has a

total potentially irrigable area of 165,000 hectares which would require an extraction rate of 52 cumecs (Kasimona and Makwaya 1995). Currently there are plans to irrigate 10,000 hectares of rice, in addition to plans for the development of the Mastock and Chiawa Irrigations schemes, with sizes and water requirements yet to be determined. There are also plans to transfer a substantial amount of water from the Kafue to the Kaleya River to increase the area of irrigated agriculture in the edaphically suitable but water-limited Southern Province. What all this means, is that future water demands in the Kafue Basin will approach supply (Nyumbu 1996). Thus, the first river to experience environmental problems in Zambia is certain to be the Kafue, the lifeline of the Kafue National Park and the Kafue Flats fisheries.

4.2.2 Fisheries¹

Approximately 300,000 households have fisheries as their primary source of sustenance, and an estimated 40% of animal protein consumed by humans in Zambia is provided by the fisheries sector. Most of the fish produced in Zambia comes from natural fisheries, and 80% of the production is achieved by some 28,000 artisanal fishermen using non-motorized boats (The Economist Intelligence Unit 1996). Aquaculture accounts for only 3.5 tons of the officially estimated 70,000 tons annual harvest. Officially, Zambia's fisheries account for about 1.2% of GDP, a figure that is most certainly a gross underestimate of the sub-sector's contribution to the national economy. As with forestry, agriculture, and wildlife, a large proportion of the economic activity pertaining to the fishing industry remains outside the official economy.

There is little doubt that several of Zambia's important fisheries are coming under increasing pressure. In Lake Tanganyika -which contains over 1300 species of invertebrates, over 500 of which are endemic (Cohen 1991) - commercial fishing boats in the early 1970's used to harvest an average of 4 tons per night. Currently, the nightly catch per vessel is a mere 1.8 tons. This same trend is evident in Lake Mweru where artisanal fishermen used to average 9 kg of fish per night. Currently the average catch per night is 2 kg of fish.

Figure 4.1 summarizes trends in total fish catches for four important fisheries in Zambia. The data, which must be viewed with skepticism, show an increase in total catches in Lake Tanganyika from the mid 1970's to 1990, when it stabilized in spite of an increase in fishing effort. Furthermore, the data for Lake Tanganyika hides a marked switch in the species and sizes of fish caught, where lake sardines, known as *kapenda* or *chinsese* have, to a large extent, replaced larger fish species such as *Stolothrissa spp.* and *Limnothrissa spp.* Finally, the absence of a declining trend in total catch for Lake Tanganyika portrayed in Figure 4.1, contrasts sharply

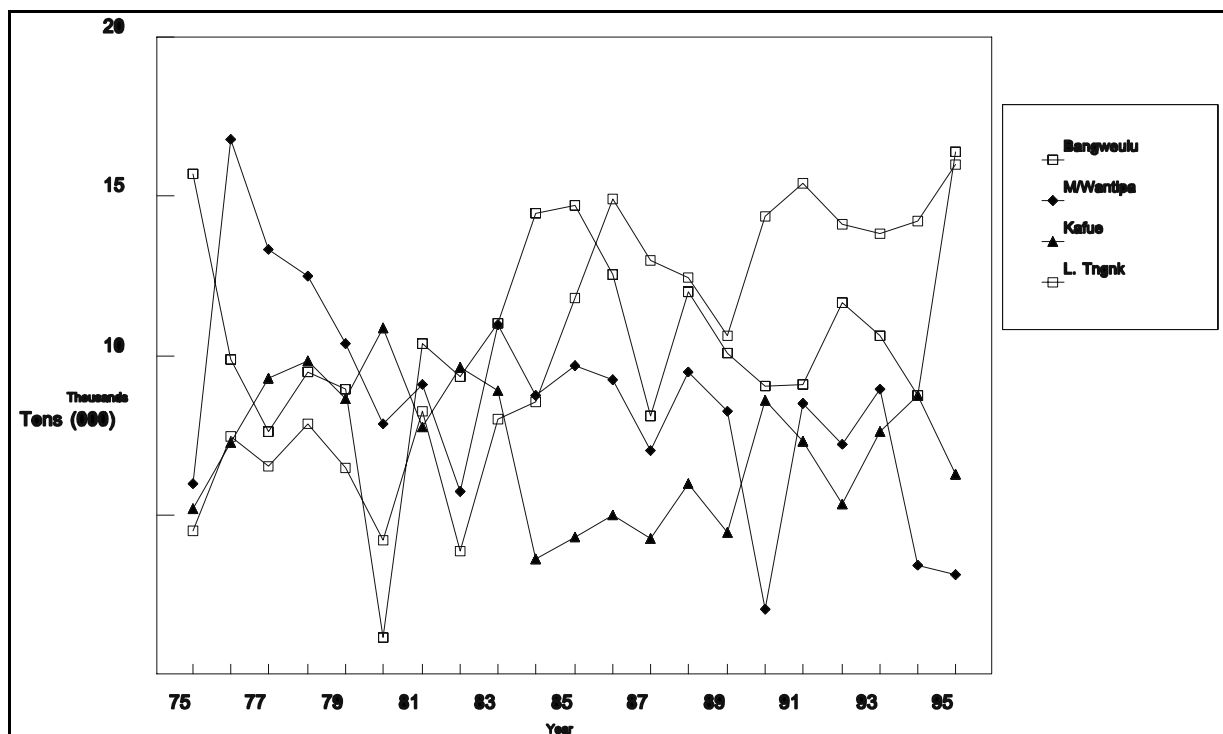


Figure 4.1. Fish catches from four important fisheries in Zambia.

with data obtained in Tanzania which show a steady decline in total catch from 115,000 tons in

1985 to 53,000 tons in 1989 (Bwathondi et al. 1993)

Annual fish catches from the Kafue river show a decline in the mid 1980's only to recover in the 1990's. This recovery in total catch, however, was associated with an increase in the number of fisherfolk. The data for Lake Mweru-Wantipa show a clear decline in fish catches in the early 1990's. In contrast, the Bangweulu system shows an increase in catch and no clear trend over time. This may be partly attributed to the difficulty in over fishing swamp ecosystems.

Within the Kafue basin, the Kafue flats are under increasing pressure from fishermen moving north from Kariba, east from the Zambezi, and south from the depleted northern fisheries and declining job opportunities. The flats have also been affected by dam-induced changes in the Kafue River's hydrologic regime and infestation by water hyacinth. These pressures are contributing to the decline in the productivity of the ecosystem. The Lukanga swamp has experienced a drop in water level and increased fishing pressure associated with an escalation of unemployment in the Copperbelt.

The decline of Zambia's fisheries productivity is associated with a decrease in per capita fish consumption in the country. In the early 1970s the per capita fish consumption stood at 12 kg per annum; today that figure is estimated to be around 8 kg per annum (Yachiyo Engineering 1995). According to Yachiyo Engineering (1995) the reversal of this trend will entail increasing the contribution of aquaculture to Zambia's fish production.

4.2.3 Consequences of trends affecting water resources and fisheries

Current problems affecting Zambia's water resources and associated fisheries can be placed in two categories: over-utilization of selected fisheries, and excessive demands and deterioration of the Kafue basin resources, particularly its water and fisheries. While it is impossible to give precise estimates of the economic consequences of over-utilization of fisheries resources to Zambia's economy, the fact that around 40% of the protein in the average Zambian's diet comes from fish products indicate that a collapse of this sector would have dire ecologic, economic, and public health consequences. Intensive fishing pressure in the Kafue Flats are particularly worrying. Furthermore, the Kafue River is the life line of the Kafue National Park which has tremendous potential as a tourist attraction.

Thirteen percent of Zambia's household have access to in-house piped water, and 25% to piped water within 100 m of the dwelling. The remaining 62%, mostly located in rural areas, obtain water from boreholes and wells (36%), rivers and streams (23%), or other sources of open water (2%) (Nyumbu 1996). Considering the large proportion of households that obtain drinking water

from wells, rivers, and streams, the importance of water quality to public health cannot be over emphasized.

4.3 Condition and Trends Affecting Forests and Woodlands

4.3.1 Protected status and management responsibilities

From a protected status perspective, Zambia's forests may be classified into three distinct categories: national forests, local forests, and open forests. Officially gazetted national forests cover 51,386 km² or 6.8% of Zambia's territory. Under the Forests Act of 1974, "all land comprised in a national forest shall be used exclusively for the conservation and development of forests with a view to securing supplies of timber and other forest produce, providing protection against floods, erosion and desiccation and maintaining the flow of rivers." The control and management of national forests is vested on the Chief Conservator, a government civil servant.

Local forests cover an additional 22,975 km² and were created for the same purpose as national forests. As far as I can determine, the difference between national and local forests rests on the provision within the Forests Act, which allows the Minister to vest management responsibilities of local forests "to any other person or authority subject to such conditions as he may think fit." Furthermore, the president may, by statutory instrument, over ride any provisions of the Forests Act as they may pertain to local forests.

Open forests are non-gazetted forested areas that occur in any state land, reserve, or trust land. When an open forest falls within the area of a local authority, the use of forest resources by local inhabitants is regulated by local by-laws. Licensing for use by outsiders is, however, under the authority of the Chief Conservator.

Thus, the management of national and local forests is vested on the Forest Department through the Chief Conservator. In these cases the community has little say as to how forest resources are to be managed. In the case of open forest, local authorities may regulate the use of forest products by local inhabitants, but are legally powerless to control the use by outsiders, provided these have licenses issued by the Forest Department.

A draft forestry bill is currently being discussed prior to consideration by parliament. This new bill, which would supersede the 1974 Forests Act, purports to increase the opportunity for local-level forest management. The draft bill prescribes the creation of A Zambia Forestry Authority (ZFA) to be run by a chief executive guided by a board of directors. The ZFA would have the legal mandate to raise and retain revenue.

The proposed forestry bill would bestow on the Minister of Environment and Natural Resources the legal right to transfer management responsibility, including the sale of licenses and retention of revenue, of forest resources on trust land to local communities. It also states that the granting of concessions or changes in the boundary of local or national forests must be preceded by consultations with local communities.

Whereas the draft forest bill would go partway towards empowering local communities to manage local forest resources, the extent to which it does so will depend on the accompanying regulations that would set the framework for its operationalization. For example, whereas the proposed forestry bill requires consultation with local communities before certain decisions are made by the ZFA, it does not specify what constitutes "consultation" nor does it state whether the community has veto power over plans with which it disagrees. The proposed bill also fails to clarify whether communities have the right to exclude outsiders, or if the ZFA retains the right to issue licenses within areas purportedly managed by local communities.

Whereas the situation of Zambia's forests has not been quantified in over 30 years, observed trends are disturbing⁴

Approximately 300,000 households have fisheries as their primary source of sustenance, and an estimated 40% of animal protein consumed by humans in Zambia is provided by the fisheries sector. Most of the fish produced in Zambia comes from natural fisheries, and 80% of the production is achieved by some 28,000 artisanal fishermen using non-motorized boats (The Economist Intelligence Unit 1996). Aquaculture accounts for only 3.5 tons of the officially estimated 70,000 tons annual harvest. Officially, Zambia's fisheries account for about 1.2% of GDP, a figure that is most certainly a gross underestimate of the sub-sector's contribution to the national economy. As with forestry, agriculture, and wildlife, a large proportion of the economic activity pertaining to the fishing industry remains outside the official economy.

There is little doubt that several of Zambia's important fisheries are coming under increasing pressure. In Lake Tanganyika -which contains over 1300 species of invertebrates, over 500 of which are endemic (Cohen 1991) - commercial fishing boats in the early 1970's used to harvest an average of 4 tons per night. Currently, the nightly catch per vessel is a mere 1.8 tons. This same trend is evident in Lake Mweru where artisanal fishermen used to average 9 kg of fish per night. Currently the average catch per night is 2 kg of fish.

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Whereas the situation of Zambia's forests has not been quantified in over 30 years, observed trends are disturbing⁵. The country-wide unweighted average deforestation rate as calculated by FAO (1986) is 5%. In a recent specimen collection trip Harder (1997; Appendix 1), noted that out of 39 protected forest sites, 29 were being openly utilized or encroached. In heavily populated areas in Central Province there is considerable pressure to de-gazette some areas. Illegal logging of high value species such as *Azela quanzensis* (pod mahogany), *Baikiaea plurijuga* (mukusi), *Faurea saligna* (sanginga), *Guibourtia coleosperma* (muzauli), and *Pterocarpus angolensis* (mukwa) is rampant where vehicle access is possible.

Illegal timber cutting and uncontrolled charcoal burning take place openly and unopposed as the Forest Department's enforcement capacity is non-existent. Since current legislation does not support community involvement on the management of forest reserves, local residents can only watch as their resource base is usurped by better connected and endowed players. Thus, Zambia's forests are left to their own devices; where access and population pressure is high, forest degradation is at an advanced stage, in isolated and less accessible areas, forest cover appear to be in reasonably good shape, irrespective of protective status.

The principal direct causes of deforestation and forest degradation are fires, charcoal burning and land clearing for agriculture. Chidumayo (1993) estimates that total charcoal consumption in Zambia can be met by only 8% of total woodfuel production from the country's woody vegetation cover. This suggests that from a country-wide perspective, the charcoal industry has only limited impact on the vegetation cover. However, as indicated above, Zambia's population is highly urbanized and concentrated in a few districts.

In contrast to the sparsely populated provinces, forest resources in Central, Lusaka and some areas in the Copperbelt provinces are under intensive pressure. Estimates of deforested areas for these three provinces range from 54% (Lusaka) to 30% (Copperbelt, Central) (ZFAPS 1995). In those provinces, fuelwood shortages are becoming a problem in many communities. Honey production is down, and land for the expansion of agriculture, the single most important factor causing deforestation, is limited (Queiroz 1997). Because of the inherently low fertility prevalent in most areas within Zambia, cultivated fields have to be moved after only a few years of cultivation.

In summary, there has been no objective assessment of the condition of the vegetation cover in Zambia for over thirty years. However, qualitative observations indicate that, on the average, the condition of the woodland and forest is relatively good. On the other hand, deforestation fueled by the expansion of agriculture, slash-and-burn practices, and fuelwood harvesting and charcoal making is severe in relatively densely populated provinces (Central, Lusaka). Selective logging takes place in areas where vehicle access is possible, leading to degradation of the forest cover. These illegal activities take place irrespective of protective status because Zambia's Forest Department is powerless to enforce regulations, and local communities have no effective legal right or capacity to control exploitation by outsiders.

4.3.2 Consequences of forest cover degradation and deforestation

The forest sector can potentially make a major contribution to national and rural household economies. Currently, woodfuel accounts for 68% of total energy supply in the country. In 1991 the charcoal industry alone accounted for 2.3% of GDP (ZFAPS 1995). It is estimated that charcoal production provides full-time employment for about 41,000 people in rural areas; another 45,000 are employed in charcoal transportation, marketing, and distribution (Hibajene and Chidumayo 1993).

In vast areas within Zambia, non-agricultural and non-timber forest and woodland products are important sources of livelihood to rural households. For example, in North Western and portions of Western Province, the bulk of household needs are met by forest products. Communities in these areas are primarily beekeepers and hunters (Noah Zimba, Research Officer, Forestry Research Division, Kibwe). Cultivation in those areas is limited due to the low fertility of Ferralsols and Arenosols, and the high incidence of pests characteristic of high rainfall areas. Other useful forest products currently used include tuber from orchids, caterpillars, wild fruits, mushrooms and medicinal plants.

Whereas it is difficult to place a figure on the current or potential value of these products, Nswana (1996) estimates that indigenous forest and woodland products sales in the Copperbelt,

Luapula and Central Provinces were around U\$ 6.0 million, U\$5.4 million, and U\$ 2.0 million respectively. In these provinces alone there are over 6500 traditional healers. The value of cures and reduction of suffering provided by traditional medicinal practices, while escaping conventional economic analysis, is likely to be very large in a country where western style medical services in remote areas are scarce or not available.

Although the readily quantifiable economic value of Zambia's forests and woodlands products are significant, it is likely to be dwarfed by the ecological services these ecosystems provide to the country and region. For example, Costanza et. al. (1997), estimated that the ecological services provided by the earth's ecosystem are worth over U\$33 trillion annually, U\$4 trillion of which are attributed to ecological services (such as gas regulation, water regulation, soil formation, nutrient cycling, habitat, erosion control, and climate regulation to name but a few) provided by tropical forests and woodlands.

4.4 Wildlife Resources

4.4.1 Categories and condition of protected areas

Protected areas for the conservation of wildlife in Zambia fall in three categories: National Parks; Game Management Areas; and Bird Sanctuaries. Together these cover nearly 30% of the country. Currently there are 19 national parks and around 33 game management areas. Table 4.2 summarizes, in a qualitative manner, the condition of Zambia's 19 national parks.

Whereas reliable data on the status of wildlife within the country do not exist (Chabwela 1996), the qualitative assessment summarized in Table 4.2 suggests that in 14 out of 19 national parks the populations of principal species are either depleted or on a downward trend. With the exception of Siomangwezi and Liuwa, currently under the administration of the Lozi people, all other parks are administered by the Department of National Parks and Wildlife Services. The two parks, Luangwa North and Luangwa South, where wildlife numbers are increasing happen to be the focus of special programs such as the NORAD-funded Luangwa Integrated Resource Development Program, the USAID-supported ADMAD, the Owen Foundation's North Luangwa National Park project, and several other smaller efforts supported by a variety of conservation organizations (Save the Rhino Trust).

The situation is not any better in game management areas adjacent to national parks. After a four-day visit and countless meetings with local inhabitants, NPWS personnel, and lodge managers, McCarthy (1997) made the following observations:

Table 4.2. Qualitative evaluation of the status of national parks (adapted from Chabwela 1996).

National Park	Year established	Area (km ²)	Dominant ecosystem	Status of principal species
Blue Lagoon	1973	450	wetlands	declining
Isangano	1957	840	wetlands/miombo/savanna	depleted
Kafue	1951	22400	miombo/savanna	declining
Kasanka	1941	390	miombo	depleted
Lavushimanda	1941	1500	miombo	depleted
Liuwa	1972	3660	grassland/wetland	declining
Lochnivar	1972	410	wetland	stable
Lower Zambezi	1983	4140	miombo/mopane	recovering
Luambe	1966	254	mopane	declining
Lukusuzi	1938	2720	miombo/mopane	depleted
Lusenga	1942	880	Grasslands/miombo	depleted
Mosi-oa-tunya	1972	66	mopane	stable
Mweru-wantipa	1942	3134	Itigi forest/Miombo	depleted
North Luangwa	1939	4636	mopane/miombo	recovering
Nsumbu	1972	2070	thicket/miombo	declining
Nyika	1972	80	montane grassland and forest	declining
Siomangwezi	1972	5246	wetland/miombo	declining
South Luangwa	1938	9050	mopane/miombo	recovering
West Lunga	1951	1684	dry miombo	declining

"In spite of the ADMADE Program operating in the region of Kafue National Park for nearly five years, the GMAs of Mumbwa and Namwala apparently continue to experience:

- continued intensive poaching pressure from the surrounding inhabitants;
- lack of training/awareness campaigns in these areas aimed at local populations regarding their identification with support of wildlife management efforts and their sharing in benefits;
- lack of identity with the ADMADE program of village scout staff due to lack of support from the National Parks and Wildlife Services (NPWS);
- inability of the NPWS staff in the region to effectively respond to poaching pressure due to lack of basic equipment, i.e. transportation, camping rations, camping equipment, ammunition, etc;
- lack of adequate basic support, i.e. accommodation, dependable water supply, etc, for NPWS staff and their families assigned to base camps in these areas in order to maintain themselves in a state of readiness to carry out their duties;
- lack of legal support for scouts who have taken action against poachers; i.e. some are being prosecuted on manslaughter charges for having taken action against poachers;
- lack of legal action/follow-up taken against convicted poachers in these areas;
- complete lack of transparency in the allocation of hunting concessions in these GMAs;
- lack of sound methodology to determine game quota allocations based on solid data, i.e. game population counts, herd structures, etc.
- lack of means to effectively track the achievement of contracted hunting quotas in these areas;
- no apparent linkage of the allocation of funds to support game management in these areas with revenue levels generated in these areas;"

Lest we think these problems are confined to the two GMAs assessed by McCarthy, Simasiku

(undated) noted that poaching was common in all nine game management areas (GMAs) that have been the target of USAID support under the ADMADE program. In fact from 1993 to 1996, a total of 1565 suspected poachers were arrested (NPWS 1996) in GMAs. Furthermore, she also noted that hunting quotas allocated by National Parks and Wildlife Services often far exceed figures arrived at by calculations utilizing game counts, and do not take into account animals poached or natural mortality. Thus, GMAs are under threat due to poaching and poor management which may be partly attributed to a lack of reliable information upon which to base hunting and culling quotas. To these threats it is necessary to add losses and degradation of habitat due to the expansion of agriculture and deforestation.

4.4.2 Consequences of the depletion of wildlife resources

Zambia's tourism is largely dependent on wildlife. While Victoria Falls may attract a significant number of tourists by itself, the better managed national parks and wildlife in Zimbabwe, Botswana, and Namibia ensures that these visitors spend the bulk of their time and money enjoying wildlife in these neighboring countries..

Whereas it is difficult to assess the potential of Zambia's tourism industry, and therefore potential losses arising from the demise of the country's wildlife resources, a look at some historical figures may be revealing. In 1981 Zambia attracted 146,694 tourists, who contributed over U\$47 (1987) million to the country's economy. Today it is estimated that the sector contributes less than U\$ 10 million annually to the country's economy (The Economist Intelligence Unit 1996). Under-funding of tourism has affected both capacity and standards.

Kenya attracts over 700,000 tourists annually. In 1994 the number of tourists to neighboring Zimbabwe exceeded one million, about 70% of which came from South Africa. These visitors contributed over U\$157 million to the Zimbabwean economy (The Economist Intelligence Unit 1996b), and their number have continued to increase over the past three years. It is, therefore, not unrealistic to expect a well managed tourist sector in Zambia to attract at least half as many people as neighboring Zimbabwe. The country contains ecosystems that easily rival those in Zimbabwe and Botswana in terms of natural beauty and wildlife carrying capacity. Thus, Zambia's wildlife sector and associated tourism industry could easily make up for over 10% of the country's GDP which currently stands at around U\$1.7 billion.

However, benefits derived from a healthy tourist industry is not the only positive side of a healthy wildlife sector. A large number of people in Zambia derive a significant proportion of their livelihood through the extraction of forest and woodland products. A key renewable product is wildlife meat. For example, an unpublished study conducted by Dale Lewis in the

Upper Lupande Game Management Area, showed that during a 6-month "poaching season" hunters from a population of 750 villagers captured, with snares, an estimated 2428 animals (mostly impala), with an average local carcass value of U\$9.0, with an estimated value of U\$21,852 for the total harvest. Eighty-four percent of the animals were sold for cash or exchanged for maize, the remainder was used for household consumption. If current trends continue, the day when subsistence hunting will become a thing of the past is not far. This cheap and ecologically sound source of protein will disappear and currently there are no obvious replacement. Livestock grazing is not a viable operation in vast areas of the country due to diseases and poor grazing typical of well-watered dystrophic systems. Arable agriculture is also limited due to edaphic conditions. Thus, there is little doubt that the depletion of wildlife will lead to a decrease in the availability of meat protein to rural households.

4.5 Soil Degradation and other agriculture related problems

4.5.1 Acidification

Soil erosion and degradation in Zambia is a localized phenomenon, estimated to cover 100,000 hectares, primarily in the south and southeast regions of the country (Chidumayo et al. 1990) where population densities are highest and soils more conducive to arable agriculture. In contrast with other African countries, soil erosion plays second fiddle to soil acidification and overall deterioration of soil tilth. These processes were created by the incentives given to maize production which included high levels of subsidy for the purchase of chemical fertilizers in the 1970s and 1980s. Accordingly, fertilizer sales rose from 3500 tons in 1964 to 250,000 tons in 1984.

Chemical by-products from the transformation of nitrogenous fertilizers in the soil contributed to a reduction in soil pH of naturally acidic soils and lowered yields. In Mpika, Serenje, and Chinsali Districts, average yields declined from 3500 kg in 1981 to 2400 kg in 1986, even though fertilizer application increased from 250 kg to 350 kg (MENR 1994). Research station trials showed decreases in yield from 5.5 to 2 tons per hectare over a period of six years due to increasing fertilizer-induced acidity (McPhillips 1990). Blackwell (1991) estimated that reductions in pH due to maize monocropping and fertilizer application will result in the loss of 15% of arable land in Northern Province.

The problems caused by excessive fertilizer application are likely to diminish because of the removal of subsidies and consequent reduction in fertilizer applications in Zambia to current levels at about half (120,000 tons) as much as those in 1984.

4.5.2 Agrochemicals

Because of the emphasis on maize, and the demise of crop rotation in the late 1980's, Zambian farmers utilized considerable amounts of fertilizers and pesticides (Sharpe 1990). This legacy persists to some extent today. Thus, in 1994 Zambia spent nearly 4 billion Kwacha on agrochemicals. This causes localized problems of pollution, and poses a health risk to ill-informed farmers. For example, drainage water from the Nkambala sugar estate contains 72% more nitrate nitrogen and 229% more ortho-phosphates than the pre-irrigation water pumped from the Kafue River.

4.5.3 Loss of agrobiodiversity

The focus on maize and agrochemicals temporarily obfuscated the need for fallow periods and crop rotations. It also led to the abandonment of traditional crops and varieties throughout Zambia (Lichte et al. 1992). For example, Chisi et. al. (1997) state that traditional sorghum production in Central, Eastern, Southern and Western Provinces has been largely displaced by maize production. Although I found no data to quantify the effects of these changes on the loss of "land races" there is little reason to dispute the claim that Zambia's indigenous gene bank suffered from the maize-centered policies of the 1970's and 1980's.

4.5.4 Consequences of the degradation of agricultural resources

Currently there is limited reason for concern over the effect of unsustainable practices on Zambia's soil resources. Erosion is not widespread, and the rate of soil acidification is likely to wane in the wake of the end to fertilizer subsidies. There is however, sufficient reason for concern over the effect of unsustainable agricultural practices on the ecological integrity of associated resources.

The rapid rate of deforestation associated with slash-and-burn agriculture in densely populated areas is a cause for concern. As described above, in some densely populated provinces (Central, Copperbelt) shortages of fuelwood are already being felt. Agriculture induced deforestation is also leading to a decrease in wildlife habitat. Planned increases in irrigated agriculture (Yashiyo Engineering 1995) may lead to the deterioration of water resources, particularly within the Kafue basin.

It is important to note that some of the main factors contributing to environmental degradation, such as fertilizer subsidies and focus on maize cropping, are no longer present. Furthermore, if given adequate tenure over agricultural resources and appropriate incentives and disincentives, market-oriented farmers in better endowed regions of the country will voluntarily invest in soil

conservation practices. USAID may make a meaningful contribution to Zambia's sustainable development if it works with small-scale producers to minimize the negative impacts of unsustainable agricultural practices on associated resources such as wildlife, forests, rivers and wetlands in agriculturally marginal regions of the country, and develop rural based alternative sources of livelihood to subsistence agriculture.

PART V. Root Causes of Environmental Threats

There is more than one way to skin a cat. Likewise, there are different interpretations and different ways in which to group root causes of environmental threats in Zambia. The scheme presented in Table 5.1 is only one of these.

In Table 5.1, the presence of one "X" in a cell signifies a moderately strong link between the root cause and the set of problems represented by the columns, two "Xs" indicates a strong link and three a very strong link. The column labelled "consequent causes" illustrates some of the immediate consequences of root causes. These are closer to the actual environmental problems.

The root causes presented in the table are related to each other in the same manner as the environmental threats themselves. The distinction between "root causes" and consequent causes" is not always clear. The intent is that the ideas summarized in Table 5.1, and ensuing discussions assist USAID/Zambia with its strategic planning process.

As in other East and Southern African countries, the lack of alternative sources of livelihood forces rural communities to over-exploit their environment. Thus, people utilize unsustainable fishing methods, fish during spawning periods, over-hunt, make charcoal, and cultivate in unsuitable areas because they have no alternative to meet their day-to-day needs. Therefore, the lack of alternative sources of livelihood to unsustainable exploitation of resources features prominently as a root cause of environmental problems afflicting fisheries, forests and woodlands, wildlife, and soil resources.

The environmental problems caused by rural households attempting to meet household needs are compounded by an institutional framework that is unable to undertake cross-sectoral management planning. Chabwela et. al. (1996) notes that there is almost a complete absence of coordination among the Ministry of Lands; Agriculture, Food and Fisheries (MAFF); Environment and Natural Resources (MENR); Mines and Minerals Development; Energy and Water Development (MEWD); and Tourism (MoT). For example, the MAFF may endorse the development of an irrigation scheme that abstracts water needed for energy generation or wildlife habitat. Conversely, the MEWD may change the flow regime of rivers with impact on fisheries,

wildlife and agriculture. Specific to wildlife, the Department of National Parks and Wildlife Services (DNPWS) in the Ministry of Tourism, is responsible for the management of large vertebrate species, but the Forest Department, in the MENR is responsible for the management of the terrestrial component of the habitat in which wildlife depend. Accordingly, the inappropriate institutional framework is another important root cause for problems afflicting Zambia's wetlands, rivers, streams, forest and wildlife resources.

Many of the problems that arise due to an inappropriate institutional framework are compounded by the weaknesses of the institutions involved. Thus, the Environmental Council of Zambia (ECZ), which has as one of its functions to coordinate the activities of all ministries concerned with the environment, is within the MENR, one of the smallest and most under-funded ministries of government (Chabwela et. al. 1996). The ECZ has amongst its myriad of responsibilities policy formulation, environmental monitoring, development of environmental standards and regulations, identification of projects for which environmental impact assessments are necessary, and carrying out activities related to the protection of the environment in accordance with the Environmental Protection and Pollution Control Act (EPPCA) (Chinene et al. 1996). This is an extremely difficult mandate for any organization, not to mention the under staffed and under-funded ECZ. The same may be said of the Forest Department, also in the MENR, which has no vehicles at its provincial headquarters in Northwestern Province, the political sub-division of Zambia with the largest area of woodlands and forests under protected status. To this set of weak government institutions, one may add the virtual absence of national NGOs with participatory NRM capacity, and weak local-level organizational and managerial capacity. Thus, weak institutional capacity, government and otherwise, is also a root cause of environmental threats to Zambia's resource base.

Many of the problems affecting Zambia's natural resources can be traced back to the lack of control communities have over the management of the resource base on which they depend. Currently, Zambia's communities have very little say as to what can be done within their area. It is true that local chiefs can control the access of local people to natural resources, but they are powerless to stop outsiders armed with centrally issued logging and hunting licenses. Local communities have no say, for example, as to which tour operator they want to enter into agreement with for the development of their area tourist potential. They have no knowledge of the amount of revenue that is derived from the externally "managed" utilization of wildlife and other forest resources. Likewise, fishing communities cannot stop "licensed" outsiders from coming in and over-exploiting fisheries resources. Thus, lack of grass roots empowerment is a fourth root cause of environmental threats.

Most of the problems affecting the government's environment-related institutions can be traced back to a lack of appreciation and knowledge of environmental threats and opportunities. In

Zambia, as in other African countries, the environment was placed in the government's agenda by donor countries. Zambian leaders themselves have yet to see the economic potential and logic of environmental conservation. This manifests itself in reduced political and financial commitment to sustainable environmental management. Witness the lack of support to the MENR, and compare it with the resources available to the MAFF. Therefore, the lack of awareness by politicians of the consequences of environmental threats, and potential for judicious NRM is identified as a fifth root cause of problems faced by Zambia's resource base.

Table 5.1. Environmental threats and their principal root causes. Three "Xs" means strong linkage between environmental threat and root cause; one "X" means weak linkage between root cause and threat.

Root Cause	Consequent causes (Illustrative)	Environmental Threat			
		Degradation of wetlands, rivers, streams (fisheries and water quality	Degradation of Forests and Woodlands	Depletion of Wildlife Resources	Degradation of Agricultural Resources (soils)
Limited alternative sources of livelihood	Over- utilization.	XXX	XXX	XXX	X
Inappropriate institutional framework	Weak institutional coordination. Conflicting policies.	XXX	XX	XX	
Weak institutional capacity (government and civic)	Weak enforcement. Weak support. Deficient environmental management planning capacity. Deficient information, knowledge, and technological base.	XXX	XXX	XXX	XXX
Deficient grass roots empowerment	Lack of transparency. Lack of grass roots representation	XX	XX	XXX	
Lack of awareness of environmental threats and opportunities.	No political or financial support for enhanced environmental management.	XX	XX	XXX	
Inappropriate regulations, laws, and policies	Inappropriate resource tenure regimes. Lack of empowerment of rural communities	XXX	XXX	XXX	

The lack of appreciation for environmental issues, subtended by a historical fixation with centralized decision making and an inadequate understanding of the requirements for integrated environmental management, is entrenched in a plethora of environmental laws and regulations that undermines the ability of government, private, and communal-based institutions to management the environment sustainably. Thus, legal tenure and management responsibilities for a number of natural resources rest with central government. Accordingly, rural communities have no legal use right or control over the access to renewable natural resources, and therefore lack incentives to sustainably manage them.

Zambia's economy and development through the 1970's and 1980's was centrally planned. During this period there was limited space for public participation and the emergence of local-level democratic institutions. Prior to independence, the colonial administration model relied heavily on traditional authorities as a means to implement colonial policies. This historic disregard for broad-based participation, coupled with the limited opportunities for education and a paternalistic central government, stifled the emergence of capable local-level institutions and individuals, and preempted the emergence of local-level democratic processes. Today, this situation limits the ability of communities to organize themselves into effective NRM units, and compromise their lobbying effectiveness. Add to this lack of capacity a legal framework that confers excessive control on central government, and we have a situation where local communities are unempowered to protect or manage local natural resources. Thus, the lack of grass-roots capacity ranks as a principal root cause of environmental problems plaguing Zambia.

Currently there is a widespread movement to modify legislation that deal with the environment. While this is welcome, legal reform is taking place at a snails pace. Furthermore, the impression one gets is that there has been insufficient consultation between departments and ministries, a deficiency that will lead to a new set of incompatible sectoral legislation. Finally some proposed legislation do not go far enough in devolving management rights to rural communities. For example, the draft Zambia Wildlife Authority Bill states that it aims "to involve local communities in the management of Game Management Areas." Involvement is a very distant cousin to either empowerment or responsibility. Thus, Zambia's inappropriate legal framework is cited as the final root cause of environmental degradation in Zambia.

PART VI. Summary and Conclusions

6.1 Reason and purpose for the threats assessment

USAID/Missions must undertake environmental threats assessment as part of their strategic planning exercise. The assessment is not only an Agency requirement, but also serves to meet the provisions of the Foreign Assistance Act (FAA) which, in essence, establishes that USAID must consider undertaking special efforts to maintain the natural resources base upon which economic growth and human well-being depend. Especial attention is to be dedicated to the conservation and management needs of biodiversity and tropical forests, defined in a broad sense to include tropical woodlands. The threats assessment should serve as a tool to be used by USAID missions to help it identify how its proposed strategic plan will meet the stipulations by the FAA.

This environmental threats assessment relied heavily on secondary sources and two field trips conducted by USAID/REDSO personnel. The volume of information on Zambia's environment is considerable, but the data are often outdated or of dubious quality. Thus, whereas qualitative agreement between documents was the norm, significant quantitative discrepancies were common.

6.2 A brief description of Zambia

Zambia is a large (750 million hectares) country hosting around 10 million people and bordering with Namibia (south/southwest), Zimbabwe (south), Mozambique (south), Malawi (east), Tanzania (north), Democratic Republic of Congo (north), and Angola (west). Its topography is rather subdued and most of the country lies between 900 and 1500 m. Zambia is a relatively well-watered country, with rainfall ranging from less than 700 mm in the south and southwest, to more than 1500 mm along the northern border with the Democratic Republic of Congo. Rainfall is unimodal, with over 90% falling between October and April. Long-term rainfall trends show a generalized decrease from 0.7 to 5.8 mm per year. The country is well endowed with surface and sub-surface water, with over 6% of its surface covered by rivers, streams, lakes and wetlands. Principal basins partly or entirely situated in the country include Lake Tanganyika and that of the Zambezi, Kafue, Luangwa and Luapula rivers.

Zambia conjures images of abundant under-utilized soils with high agronomic aptitude. Close scrutiny of the available data reveals a different picture as an estimated 90% of the country's surface is covered by soils with severe limitations to arable agriculture. This leaves around 8.8 million hectares of land with moderate to good agronomic potential. Of these, only a fraction (around 10%) is cultivated. Thus, while Zambia's surface is dominated by soils that are poor for arable agriculture, only a fraction of its potentially arable land is actually cultivated. The fact that the large majority of Zambia's surface is not suitable for arable agriculture means the utilization of vast areas will have to rely on the sustainable management of renewable resources such as forests, fisheries, and wildlife.

An estimated sixty-nine percent of Zambia's surface is covered by woodlands. Chief amongst them are miombo woodlands dominated by *Brachystegia spp.*, *Julbernardia spp.*, and *Isoberlinia*. Wooded mopane (*Colophospermum spp.*) grasslands, undifferentiated bushlands and thickets, evergreen forests and cultivated crops complete Zambia's vegetation cover.

Zambia is reputedly the most urbanized country in sub-saharan Africa, with 42% of its population residing in urban areas. Its population of 10 million grows at an estimated annual rate of 2.7%, down from 3.1% in the 1970s. Manufacturing is the main contributor to GDP (25%), followed by Agriculture, Fisheries and Forestry (18%), and mining (6%). Agriculture, forestry and fisheries are the primary source of livelihood for over 50% of the populations. On the average, 70% of household income is spent on food.

Maize is the main crop for subsistence and cash, covering over 50% of the total cultivated area. Of the 520,000 farming households, 92% produce primarily for subsistence. Mean area cultivated per household is 2.2 hectares. The livestock herd, concentrated in the drier portions of the country, contains 2.2 million head of cattle 592,000 sheep and goats, and 303,000 pigs. Eighty-two percent of the cattle herd is reared by traditional producers.

Officially Zambia's fisheries contributes 1.2% to GDP. This figure is undoubtedly an underestimate. Around 40% of animal protein consumed in Zambia comes from this resource. Official figures place the total annual fish catch at 70,000 tons.

The contribution of forestry to GDP falls between 0.9% and 3.0%, both likely underestimates. Woodfuel accounts for around 71% of Zambia's total energy consumption, and 96% of household energy consumption. Woodland-based beekeeping is the principal economic activity of rural households in vast areas of the well-watered portions of northern and northwestern Zambia. National honey production is estimated to be 1500 tons per year.

6.3 Environmental threats

6.3.1 Water resources, rivers, streams, lakes and fisheries

Zambia faces no shortage of water. Current consumption amounts to only 2% of total available water. Projections of water consumption patterns through 2015 indicate that total consumption will increase to only 7% of total available water. The situation as far as water quality is concerned is also favorable with the exception of the Kafue river where high turbidity and high nutrient content affect the upper and lower portions of the river respectively. Future demands for

Kafue river water, and proximity of this water course to mining areas and urban centers, indicate that the Kafue river system will face environmental problems in the near future.

Although Zambia is awash in water resources, culinary water availability is a problem. Over 62% of the nation's households obtain untreated water from wells, boreholes, rivers, lakes and streams.

There are various signs that Zambia's fisheries resources are under threat. Fish catch per unit effort has declined in Lake Tanganyika, Lake Mweru, and the Kafue flats, three of Zambia's most important fisheries. This trend is reflected in a decrease in per capita fish consumption from 12 kg in the 1970s to 8 Kg today. The reversal of this trend will entail an increase in the production of fish from aquaculture.

6.3.2 Condition and trend of forests and woodlands

From a protected status perspective, Zambia's forests may be classified into three distinct categories: national forests, local forests, and open forests. Officially gazetted national forests cover 51,386 km² or 6.8% of Zambia's territory. Local forests cover an additional 22,975 km². The difference between national and local forests rests on the provision within the Forests Act, which allows the Minister to vest management responsibilities of local forests "to any other person or authority subject to such conditions as he may think fit."

Open forests are non-gazetted forested areas that occur in any state land, reserve, or trust land. When an open forest falls within the area of a local authority, the use of forest resources by local inhabitants is regulated by local by-laws. Licensing for use by outsiders is, however, under the authority of the Chief Conservator.

A draft forestry bill is currently being discussed. This draft bill, purports to increase the opportunity for local-level forest management, and bestows on the Minister of Environment and Natural Resources the legal right to transfer management responsibility, including the sale of licenses and retention of revenue, of forest resources on trust land to local communities. Many aspects of the proposed forest bill will have to be clarified by accompanying regulations. Only when these are in place will it be possible to assess to what extent communities are truly empowered to manage forest resources.

While the situation of Zambia's forests has not been quantified in over 30 years, observed trends are disturbing. The country-wide unweighted average deforestation rate is estimated to be 5%. This is caused primarily by fires, charcoal burning, and land clearing for agriculture.

Most protected forest sites, are being openly utilized or encroached. In heavily populated areas in

Central Province there is considerable pressure to de-gazette some areas. Illegal logging of high value species such as *Azelia quanzensis* (pod mahogany), *Baikiaea plurijuga* (mukusi), *Faurea saligna* (sanginga), *Guibourtia coleosperma* (muzauli), and *Pterocarpus angolensis* (mukwa) is rampant. Illegal and unsustainable use take place because the Forest Department's enforcement capacity is non-existent, and current legislation does not support community involvement on the management of forest reserves. Thus, Zambia's forests are left to their own devices; where access and population pressure is high -Copperbelt, Lusaka, and Central provinces- forest degradation is at an advanced stage; in isolated and less accessible areas, forest cover appear to be in reasonably good shape, irrespective of protective status.

The forest sector can potentially make a major contribution to the national and rural household economies. Currently woodfuel accounts for 68% of total energy supply in the country. In 1991 the charcoal industry alone accounted for 2.3% of GDP. It is estimated that charcoal production provides full-time employment for about 41,000 people in rural areas; another 45,000 are employed in charcoal transportation, marketing, and distribution. Whereas the readily quantifiable economic value of Zambia's forests and woodlands products are significant, it is likely to be dwarfed by the ecological services these ecosystems provide to the country and region.

6.3.3 The condition and trend of wildlife resources.

Protected areas for the conservation of wildlife in Zambia fall in three categories: National Parks; Game Management Areas; and Bird Sanctuaries. Together these cover nearly 30% of the country. Currently there are 19 national parks and around 33 game management areas.

With few exceptions, the rate of depletion of wildlife resources is alarming. In 14 out of 19 national parks the populations of principal species are either depleted or on a downward trend. The situation is not any better in game management areas (GMA) where poaching is common. Because of an inadequate data base, hunting quotas allocated by National Parks and Wildlife Services often far exceed sustainable levels. Thus, GMAs are under threat due to poaching and poor management. To these direct threats it is necessary to add losses and degradation of habitat due to the expansion of agriculture and deforestation.

Whereas it is difficult to assess the potential of Zambia's tourism industry, and therefore potential losses arising from the demise of the country's wildlife resources, a look at some historical figures reveal that in 1981 Zambia attracted 146,694 tourists, who contributed over US\$47 (1987) million to the country's economy. Today it is estimated that the sector contributes less than US\$ 10 million annually to the country's economy. In contrast, over one million tourists visited Zimbabwe and contributed over US\$157 million to that country's economy. Thus, Zambia's

wildlife sector and associated tourism industry could easily make up for over 10% of the country's GDP which currently stands at around US\$1.7 billion.

6.3.4 Condition and trend affecting agricultural resources

Soil erosion and degradation in Zambia is a localized phenomenon, estimated to cover 100,000 hectares, primarily in the south and southeast regions of the country (Chidumayo et al. 1990) where population densities are highest and soils more conducive to arable agriculture. Soil acidification fueled by government subsidies of fertilizers during the 1970s and 1980's is a more pervasive problem. Chemical by-products from the transformation of nitrogenous fertilizers led to reductions in soil pH of already acidic soils. Lowered pH values lowered productivity by as much as one half of maximum maize yields in some areas. The problems caused by excessive fertilizer application are likely to diminish because of the removal of subsidies and consequent reduction in fertilizer applications in Zambia to levels about half (120,000 tons) as much as those in 1984.

Because of the emphasis on maize, and the demise of crop rotation in the late 1980's, Zambian farmers utilized considerable amounts of fertilizers and pesticides. This legacy persists to some extent today, and causes localized pollution problems.

The rapid rate of deforestation associated with slash-and-burn agriculture in densely populated areas is partly due to the poor quality of most of Zambia's soils. This practice is one of the main causes of deforestation in Zambia.

6.3.4 Root causes and recommendations

The threats assessment identified 6 root causes for the environmental problems afflicting Zambia.

First, limited alternative sources of livelihood forces rural households to utilize resources in an unsustainable manner. Second, an institutional framework that is unable to undertake cross-sectoral management planning. Third, weak government and non-government institutions that are unable to either regulate or facilitate sustainable NRM. Fourth, weak local-level institutions that are unable to transmit grass roots expectations, lobby for greater local community empowerment, or sustainably manage natural resources. Fifth, lack of awareness on the part of policy makers of the potential of sustainable NRM. Sixth, lack of an appropriate legal and regulatory framework.

Given these root causes and environmental threats, several areas for USAID/Zambia involvement in the NRM arena emerge. From a thematic perspective, USAID could address the root causes of

deforestation, over fishing, and wildlife depletion. These are the principal environmental threats afflicting Zambia. To resolve these environmental problems, USAID Zambia should consider the following intermediate results.

First, increase the spectrum of alternative sources of livelihood available to local residents. This would include the facilitation of the emergence of NRM based rural enterprises such as honey and wax processing, mushroom packaging and marketing, sustainable forestry, game ranching, meat (biltong) processing, sustainable agricultural practices and others. The exact rainbow of options could be determined through a study of potential products and regional and international markets, especially for "organic" and fairly traded products.

Second, depending on the set of resources with which USAID decides to work, it should aim to elevate the capacity of government and non-government organizations with respect to technical skills and participatory methods of rural development. Because of the inappropriate national level institutional set-up, these efforts should be concentrated at the local level, around problems that bring individuals and institutions representing different sectors together.

Third, USAID/Zambia should place particular emphasis in elevating the organizational, administrative, lobbying, and technical capacity of community-based organizations. This should be supported by strategic legal advice. The value of this experience is centered more on the lessons and models that will emerge than on the number of people impacted.

Fourth, USAID/Zambia should continue to support policy and legal reforms. This should be a priority component of the mission's strategy. Whereas legal reform is moving at a snails pace, the trend is positive. USAID can take advantage of the opportunities offered by forthcoming legislation by being actively involved in the formulation of accompanying regulations.

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Appendix I

Forest Threats Initiative Protected Area Status

Daniel Harder
Missouri Botanical Garden

Northern Province:

Mbala District: visited in November - December 1993.

Mpulungu Protected Forest Area (#45) at Mbete Bay. Tall *miombo* forest area on rocky soils. High population activities, encroachment and conversion of landscape due to human activities of charcoal cutting and preparation, water access and agricultural production. Botanical diversity detrimentally affected by agricultural land conversion although soils too rocky and infertile to support agricultural production for too long. Biodiversity localized in small remaining forest patches. Large trees still standing in several patches of good *miombo* vegetation of Brachystegia spp.

Mbala - Mpulungu road to power station. Hilly topography of *miombo* vegetation. Near southern end of Lake Tanganyika. Village settlements localized with some impact on this large area. Topography is hilly enough to hinder some encroachment. Good combination of a variety of habitat. Threatened only if population settlement patterns expand into this area.

Lungu Protected Forest Area contiguous with Kalombo Falls National Heritage site. Ridge top *miombo* woodland with sandy soils and large boulders. Rich area botanically and significant archeological record of human use and habitation. On slopes towards Lake Tanganyika recent settlements have opened up large areas for cultivations on poor soils. Some level of protection is required now to prevent further land conversion.

Kaputa District: visited in December 1993

Nsumbu (Sumbu) National Park, Kampasa Rain Forest. Small forest patch along shore of Lake Tanganyika. Very small refugia of once extensive lake side vegetation. Heavily sampled for medicinal and food sources by local populations. Also heavily traveled for lake access.

Nsumbu (Sumbu) National Park, Nkamba Bay Valley Area, Forest on steep slopes, dry water falls and river valleys. Well protected *miombo* and forested areas in buffer zone around Nsumbu National Park. Isolated areas supporting game populations at the National Park. Relatively high botanical diversity but very dry in the late dry season. Area easily accessible by the National Park and could support safari operators.

Nsumbu (Sumbu) National Park. Chilanga Rocks Campground. Lake side vegetation within the national park so some level of organized protection. Good game viewing. Botanical diversity moderately affected by relatively high animal populations (elephants and hippo).

Nsumbu (Sumbu) National Park. Along entrance road in thicket patches. Heavily grazed and influenced by elephant activity. Creates dense thicket vegetation with wide open areas in between. Low botanical diversity. Some human activities because of location along access road. Good game viewing.

Nsumbu (Sumbu) National Park. Along Lufubu River at Mwepwe Falls (Kafuna Falls). Very small patches of dense forest near falls area and up nearby slope. This patch of forest is extremely small and is subject to high human dependency as a source of food, fuel, construction, etc.. from the nearby villages. The area surrounding this patch is densely populated with villages and encroachment and conversion of this area is inevitable. The flora is diverse and in need of protection at some level.

Mweru Wantipa National Park. Open grasslands, disturbed *miombo* vegetation, lake side strand vegetation, thicket patches. National Park heavily encroached by collectors of foods, charcoal, medicine, building materials, etc and by poachers. Lake also used extensively by near-shore fishermen. Most of what was seen was converted landscapes and land conversion by local human populations. Widespread weed flora and low native plant populations along roadside and in disturbed areas.

Chishimba Falls, National Heritage Site. Riverine vegetation, local, high humidity microclimate, intact *miombo*, rocky outcrops and dambo vegetation. High plant diversity. Low animal population density. Good protective status owing to conscientious conservation practices and on-site protection.

Mpika District: visited May 1994.

North Luangwa National Park. Mano Camp, Elephants Playground, valley bottom and Mwaleshi River. Vegetation mapped and categorized by P. Smith. Good protection of

biodiversity, at the time, under the control of the Owens's. Some areas are subject to high concentrations of animals particularly during the dry season with negative effects on the populations of plants. Good extant vegetation with extensive *miombo* woodland, riverine vegetation, and *mopane* woodland.

Umpamadzi School and village. Local forest area. Highly disturbed woodland but some enhancement of botanical diversity along banks of small streams.

Nachikufu Cave National Monument. Approximately 2km N of Mpika - Serenje road and approximately 62km WSW of Mpika near Koloswe village and school. Very small protected site. Cave in rocky hills and not very diverse botanically. Numerous villages nearby and high human population density. Several naturalized weeds at site and these are encroaching on the National Monument. More appropriate protection is necessary if the site is to be preserved.

Isoka District: visited May 1994.

Approximately 95km from Isoka near turnoff to Muyombe. Excellent riverine forest vegetation. High botanical diversity with *miombo*, *dambo*, and riverine vegetation occurring together. Very low human population density so good maintenance of botanical diversity, few animals.

Along road to Muyombe not less than 19km NW of intersection of Isoka-Nakonde road and road to Muyombe. Riverine forest near permanent water. Good diversity. Some human encroachment and scattered villages in the area concentrated along the roadway. Area used for hunting of game (not plentiful). Widespread cultivation but also extensive flooded lands.

Fungwe National Forest number 429. Approximately 87km ESE of intersection of Mpika - Nakonde highway (Great North Road) on road (RD72) to Muyombe connecting to Muyombe (M14). Excellent *miombo* woodland, riverine, and valley bottom vegetation with permanent water along Kabundi stream. Some localized human impact for charcoal sources and medicinal plant harvesting.

Mpande Hills, Approximately 37km SE of Tunduma on the Tunduma - Chitipa (Malawi) road (M14). Open grasslands, dambos, and some cultivated fields. Good mix of vegetation types. Presently unprotected possibly worthy of protection. Low human population density but obvious evidence of human impact through grazing and fuelwood extraction.

Mporokoso District: visited 9 December 1993

Road between Mporokoso and Kasama (between 30.6km and 95km) ESE of intersection of Mporokoso - Kasama - Nsama roads N of Mporokoso. Collections along roadside in degraded *miombo* woodland, *dambo* vegetation, and along seasonal streams. This stretch of road passes through large floodplain areas and is dotted with frequent *dambo* vegetation rich in suffrutescent plant life. None of these areas are protected and *dambos* are frequently utilized for dry season cropping of maize. *Dambos* in general are very rich in non-grass species of dicots and monocots, most flowering after the grasses are removed by fire. Some of these areas could be conserved to protect the contained botanical diversity.

Chinsali District: visited 17 May 1994

Chipomo Falls National Heritage site. Along Chimanabuwu River, Well protected site with full time responsible at site. Rocky outcrops, riverine, *mushitu*, *miombo*, and marsh vegetation. Little local impact except some access to river for recreation and fishing.

Ikola Hills, near Misale and Chunga villages. Seasonal marsh and grasslands in low lying areas and *miombo* woodland on raised areas. Grasslands and marshes used for dry season grazing pasture and some crops. High human population density. Pockets of high botanical diversity in hills and in seasonal inundated grasslands.

Copperbelt Province:

Mwekera Forest College, Mwekera Botanical Reserve. Approximately 0.25km NE of Mwekera Dam/Reservoir near bee house. Very disturbed site. Ideally located for teaching purposes at Forestry College. Some intact large trees and understory vegetation. Encroachment is severe within the reserve from local farmers. Increased protection and some management is necessary to preserve the site. Should be administered through the Forestry College.

Ndola Rural District: visited 30 April 1994

Manda *mushitu*, at Lukoshi, at intersection of roads to St. Anthony's Mission and Mukumpu School roads, at Kabunda village. This *mushitu* (permanently inundated forest) is the largest in Zambia and most rich botanically. Not presently protected it supplies Kabunda with plant products for medicinals, food and construction. Also very rich in bird species. Some sort of protection for this unique vegetation type within Zambia is recommended.

Kashiba Lake National Heritage Site. 2.1km from entrance to St. Anthony's Mission. Brachystegia (*miombo*) woodland. Small patch of protected area surrounded by high human

population density with high impact on the site.

Kafue River floodplain, along road between St. Anthony's Mission and Kafue River. Closed *miombo* woodland to marsh to riverine forest. Some dry season cropping on floodplain and fishing access but otherwise an area of low impact by the local inhabitants. High botanical diversity. Potential site for some protection.

Northwestern Province:

Solwezi District: visited February 1995.

Acres National Forest Reserve: eastern border along road connecting Solwezi and Mwinilunga. *Miombo* vegetation on sandy soil with extensive termite mounds. Frequent evidence of charcoal burning and tree removal for construction? Good isolation, not necessarily high botanical diversity. Good *miombo*.

Jirundu National Forest Reserve (Botanical Reserve). Extensive marshlands, swamp, rocky outcrops and *miombo* vegetation makes this area extremely rich in botanical diversity. Area is reported to be inhabited by spirits and is considered sacred by local villages so area is under appropriate local protection. Only encroachment is the use of the rocky outcrops to prepare cassava and washing of clothes. Possibly one of the most diverse botanical sites in Zambia.

Kifubwa (Chifubwa) Gorge National Monument. National Heritage Site. Approximately 5km S along Kyalalankuba Road from Solwezi and approx. 2km S of entrance to Solwezi Teacher Training College. Riverine and rocky outcrop habitat with mixed *miombo* woodland and dense riverine forest. Soils shallow and easily disturbed. Local use of this area is heavy because of its easy access to Solwezi. Local dependency on this area for firewood, medicinals and wild collected fruits and tubers. No protection measures were evident.

Along St. Francis road past Chief Kapizimpanga's Palace. Highly disturbed and modified by human activity. Rocky outcrops and shallow soils. Not protected. Just an interesting area.

Jiwundu Resettlement Area. Along Jiwundu River. Also a high human impact area of government housing and agricultural fields. Collections along or near river in narrow band of riverine vegetation. Very high water flow during this season. Human dependency very high.

Muhlilanshima Hill, along Mwinilunga - Solwezi road. Unprotected area of rocky

outcrops. Good xerophytic vegetation. Low human impact except for removal of trees for construction and charcoal.

Kabompo District: visited 9 March 1995.

Kambyenyuna Forest. Along the Kabompo - Mwinilunga road, approximately 11km from the Loloma Hospital road junction in Manyinga. Degraded woodland on sand. Area contains a seasonally flooded plain along the Manyi River. Some good *miombo* woodland patches but mostly degraded by local human activity. Large timber trees have been extracted with associated affects on areas and vegetation.

Kamweji Marsh, Trust Land #1, Chizela Game Management Area #3. Along old Kasempa - Solwezi highway. Approximately 37 km ENE of Chipoya Bridge at Samsole village. Extensive grassland and marsh. Some local encroachment for dry season cropping of maize and grazing. Protection of watershed is essential for health and prosperity of area. Not notable botanically except that is protected by its vastness.

Mwinilunga District: visited February 1995.

Nkunyi Protected Forest Area. Nearly 10 km S of intersection of Luawu-Mwinilunga road and Mwinilunga - Kabompo road. Disturbed mosaic of *miombo* woodland and *Marquesian* woodland. Good botanical diversity with most disturbance near roadside (collecting wood, medicinals, charcoal production and local cattle grazing).

Musangila (Musanila) stream. 25km W of intersection of T5 and RD287 on Mwinilunga-Lwawu Road. Heavily disturbed area. Numerous villages and extensive evidence of encroachment on the vegetation and landscape. Cultivated fields and charcoal production serve to lower botanical diversity in these sites

Ikelenge, Nchila Wildlife Reserve at Hillwood Farms. *Mavunda* thicket in patches with degraded woodland and grassland areas. Private land with owner seeking to develop the land into a game/safari viewing enterprise. Well protected yet small forest patches heavily grazed and influenced by contained animals. Not accessible to local populations so encroachment is controlled.

Ikelenge, Kalene Hill near Ikelenge Mission. Hill *miombo*, *Marquesian* woodland with rocky outcrops. Once private land now locally protected by local chieftain. Some exotic plants have been introduced and are now naturalized. Tenuous local protection at present.

Ikelenge, Kavunga Protected Forest Area, adjacent to Nchila Wildlife Reserve at Hillwood Farms. Degraded *miombo* woodland. Some evidence of human encroachment (ie. charcoal preparation and agricultural land conversion) becoming more severe. Not very diverse site but mature specimens of Brachystegia.

Ikelenge, Milomba Hill. Approximately 12km from the turnoff of Kalene Hill road and 12.6km from Ikelenge Hospital. Good roadside vegetation. A long distance to human habitation, so low impact. Good potential for conservation of *miombo* and *Marquesian* woodland vegetation types.

Lwawu Mission. Approximately 47km W of Mwinilunga and 4.7km W of mission along Lushimba River. Good riverine habitat. Some dry season cropping on flood plain when water recedes. Protected by mission but also highly impacted by local activity. Good forest vegetation.

Luaw Chana (Plain) at source of Luaw River. Approximately 19km NNE of Luawu Mission on Luawu Mission - Ikelenge Road. Expansive seasonally inundated plain with grasses, suffretex Syzygium and Protea. Very little human impact on plain except possibly annual burning of the grasses and seasonal grazing. Excellent conservation potential for watershed protection and botanical diversity.

Mavunda thicket. Approximately 19km S of Mwinilunga on Mwinilunga - Lwawu road. As of yet unprotected vegetation type. Thicket vegetation on sand, difficult to convert to agriculture and productivity on this soil type is short lived. Also difficult to burn. Very rich in endemic plant species including orchids and shrub vegetation. Human impact unassessed but appeared low.

Lisombo Botanical Reserve, Along the Lisombo stream. 26km W of Ikelenge in Kafweko Protected Forest area near Angolan border. Tall *miombo* woodland vegetation and localized riverine vegetation. Some local habitations but appears to be seasonally occupied. Excellent riverine vegetation but some dry season cropping in flood plain areas. Good epiphytic flora. Area is embedded in Kafweko Forest protection zone and should be further monitored for continued and enhanced protection.

Zambezi Source National Heritage Site. Approximately 18km S of Ikelenge then 4.8km E on access road from Ikelenge - Mwinilunga road. Riverine forest and surrounding watershed of seasonally inundated forest, disturbed woodland and open grasslands. Numerous new records and some new species from our collections. Some local impact on site and, since the protected site is small and very significant, the site is worthy of increased protection and some maintenance.

Kalene - Salujinga Road. Kalene Hill, Kyula Village, Kanyale stream, Zambezi River and floodplain, and Jimbe stream. Road passes through areas of rocky outcrop, extensive *Marquesia* woodland, riverine and marsh vegetation types; a unique mix of vegetation type for Zambia. Possible site for some protection and certainly more collecting of plants and animals.

Mulumbi Hill. Approximately 5km SSE of Kalene Hill along Kalene Ridge. Excellent woodland areas with rocky outcrops. Site worthy of some protection based on diversity of plants collected there. Some local encroachment for fuelwood and food/medicinal plant harvesting and grazing could convert this area into villages or small farms.

Kasempa District: visited 7 March 1995.

Kasempa, Kamusongwe Hill directly behind Kamusongwe Prison. Botanically diverse site of hill *miombo*, rocky outcrops and drier vegetation types. Some naturalization of introduced weeds. Rocky outcrops support succulents and increase diversity. Heavily utilized and very accessible to local populations. Hill surrounded by agricultural fields and prison grounds.

Ndenda National Forest. In chief Kasempa's area. Extensive *miombo* vegetation, some weedy vegetation along roadside. Not much apparent human impact.

Western Province:

Kaoma District: visited 29 February 1996.

Along Kalamba River and at Kimbananga Village (Chief Chitwa). Riverine vegetation and *mavunda* thicket. Good protection because thicket sites are difficult to convert to agriculture and soils are poor once natural vegetation is removed. Local populations have sampled these areas for medicinal and construction products. Unfortunately, no thickets of this type are under any national protection. Many endemic species occur in these thickets and demand protection. Deep Kalahari sands cover this area and support thicket vegetation types.

Kaoma - Kasempa road. Between 6km and 24km W of Kaoma turnoff on Lusaka - Mongu road. Main vegetation types shift from *miombo* woodland on Kalahari sand to boggy grassland plain to *Mavunda* thicket on white sands. Area slightly disturbed by the activity of widely scattered village groupings. Some grazing throughout and wood fuel collection. Good diversity botanically.

Lukulu District: visited 3 March 1996.

Along Lukulu - Kaoma road, approximately 84km NW of intersection with Mongu - Lusaka road. Good thicket and *Marquesian* woodland on Kalahari sand. Diverse site near habitations, expansive agricultural fields, and military base. Considerable local encroachment.

Kananfende Local Forest, 3km from Lukulu - Kaoma road in Chief Kabangu's area. Good *Marquesian* woodland vegetation but high human impact. Area used for grazing, wood extraction and plant collection.

Mongu District: visited 16 march 1996.

Miulwe Plain, Zambezi floodplain vegetation. Some seasonal cropping, considerable dry season grazing of cattle. Increased grazing pressure has introduced exotic plant species and trampled much of the area. Increased human population in the area will affect management of natural resources in the area. Mostly grasslands and useful for grazing.

Ituku Plain, *Hymenocardia chipya* thickets. Also extensively grazed and cultivated during the dry season. Many naturalized weed species no local protection. Increases in population of humans and cattle will adversely affect botanical diversity in this area of already high human activity pressures.

Opposite Simulumbe Agricultural Station. Mixed *Baikiaea* forest on deep Kalahari sands. Good diversity for a high grazing and agricultural site. Good site for repeat visit for seeds of plant genetic resources of cultivated crop plants. Not protected.

Sungutu Local Forest. 48.6km S-E of Mongu boma and 27km off Mongu - Kaoma road on Mongu - Lusaka road. Vegetation with some *Cryptosepalum* on deep Kalahari Sands. Severely degraded vegetation and numerous naturalized weeds.

Katoba Local Forest number 286 including Lukolo plain near Namilia village. Approximately 3km E of intersection of Katoba access road and Mongu - Senanga road. Kalahari woodland of *Marquesia* sp. Locally disturbed with numerous villages and inhabitation. Shifting cultivation practices have pretty much affected the entire local forest area and reduced the flora.

Senanaga District: visited 19 March 1996.

Along road to Kalabo in Mutemwa forest. Buffer zone for adjacent protected forest area.

High human influence and tree cutting but not too severe at present. Along well traveled road allows ease of access. Good diversity but declining.

Kalabo District: visited 20 March 1996.

Lukona Local Forest, near Lukona Basic School. Heavily encroached by local inhabitants.

Kalamaba Local Forest (no. 379). 5.6km W of Kama Health Center, 5.5km E of Lukona Secondary School. Good Cryptosepalum forest on deep Kalahari Sand. Not susceptible to fire due to low fuel loads. Some *Mavunda* thicket vegetation. Good site for increased protection of these unique vegetation types. Low human impact but some extraction of plants for construction, fuel and food.

Sesheke District: visited 4 March 1996.

Mulobezi, Namena Settlement in Kazu National Forest. 27km W of Mulobezi and then 7km off the Mulobezi - Sesheke road. Collections on Kalahari sand and in Marquesia woodland vegetation. High, yet localized human impact. Some settlements are deep inside the National Forest.

Lusaka Province: 1993, 1994, 1995, 1996, 1997

Lower Zambezi National Park. Along Zambezi River, approximately 2km from Tourist Encampment and near confluence of Zambezi and a small tributary. Marshy areas, open riverine flood plain and *mopane* woodland. Under National Parks protection. Area highly grazed and affected by herds of wild game.

Shimabala Cave National Heritage Site. Approximately 1km N of Kafue Road near Chilanga Cement housing (approximately 10km S of Chilanga and 23km S of Lusaka). Small protected area. Once overseen by a responsible for the site but now there is no protection. A small site protecting the cave entrance and surrounding vegetation of *miombo* and rocky hillsides. A site worthy of continued and increased protection due to its unique situation and proximity to Lusaka. Good botanical diversity with some invasive, naturalized introduced weeds.

Kafue Escarpment, Nachitete River road along access road of ZESCO power lines includes the villages of Chipapa, Chiyaba, Muchuchoma at Changsha stream, and Kanyanja at Kanyanja Lake. Due to altitudinal gradient a mix of vegetation types occurs along this road

including *miombo*, savanna, cultivated fields, rocky outcrops of limestone and quartz, and riverine forests. Due to its proximity to Lusaka and to the fact that this part of the escarpment has very little area under protection, it would be a suitable area for formalized protective status.

Southern Province:

Livingstone District: visited 1993 and 1997.

Mosi-oa-Tunia National Park, World Heritage Site. In palm grove near Boiling Pots. Seasonally inundated areas and subject to mist from Falls. Very disturbed rainforest vegetation. Under national and international protection but a heavy use area. Abundant naturalized weed flora. Under National Parks, International, and National Heritage Conservation Commission protection.

Mosi-oa-Tunia National Park, World Heritage Site. Songwe Gorge Lookout, approximately 5km SW of intersection of Zimbabwe - Livingstone road and road to Fifth Gorge. *Miombo* woodland with intrusions of Kalahari Sands. Heavily grazed area. Very susceptible to overgrazing due to severity of dry season effects and rocky, fragile soils. Some rare plants found only in the lower gorge area in need of protection and identification. Technically under National Parks and National Heritage Conservation Commission protection but this area is also utilized by local populations.

Simonga village, along Nakatindi (Livingstone - Sesheke) road, between 20 - 32km W of Livingstone. Thicket vegetation on Kalahari sands. Extremely rich in botanical diversity although area is dotted with small village grouping, most along or near the banks of the Zambezi. Patches of forest and woodland exist but are severely threatened by human activities including charcoal production and harvesting for construction purposes. Some of these vegetation types are unique in Zambia and represent extensions of a more southern flora and therefore are in need of protection.

Katombora Local Forest #30. Approximately 27km W of intersection of Lusaka road and Livingstone - Sesheke road in Livingstone. Degraded Baieaea forest and *Mutemwa* thicket on Kalahari Sand. Area disturbed by high human population and associated activities of grazing and cultivations. Very interesting botanically because several vegetation elements are represented in the flora. Local forest protection does not seem to be enough to preserve this area and possibly increased protection is necessary.

Sesheke District: visited March 1996.

Nanga National Forest. Approximately 29km NW of Mulobezi Boma and 17.5km N of

intersection of Sesheke and Schili roads. Good representation of Baikiaea forest with some Baphia. Some protection under national forest mandate but most of the largest trees have been removed with subsequent impact on the vegetation. High human impact and this area is still recovering from the logging boom.

Gwembe District: visited March 1997

Proposed botanical reserves. Two sites one at approximately 9km NW of Sinazeze and Choma - Maamba on road to Choma and the other near Chilamalila Hill, approximately 19km W of intersection of road to Sinazongwe and Choma - Maamba road, then S then E 6km towards Sialwala Primary School. Sites of rocky outcrop, thorn scrub and hill *miombo* vegetation. Both sites very disturbed and may have once been worthy of protection but not too converted for any botanical interest. High human impact through fuel wood collection and intensive grazing pressure.

Sinazongwe District: visited February 1997.

Chete Island Game Park. On eastern edge of Lake Kariba. Heavily grazed by wild animals and trampled by elephant populations. *Combretum* woodland much disturbed. Numerous introduced and naturalized weeds. Flora truncated due to animal grazing. Some protection for the animals is necessary especially those poached by fishermen who come ashore and kill animals. It is too late to save the plants.

Namwala District: visited February 1997.

Ila National Forest. 11km W of Namwala along motor able dirt track. In *Miombo* - Terminalia woodland and adjacent *dambo* and marsh area. Disturbed area through grazing and charcoal production and of low botanical diversity. We were told the most diverse part of the National Forest was inaccessible at that time of year and was located further west. The Forestry Department at Namwala does not have the means necessary to patrol these areas and protect the forest. Unfortunately this is true of the entire country.

Central Province: November 1993, May 1994,

Kasanka National Park, Musande Tent Camp along Luwombwa River. Intact *miombo* woodland, *mushitu*, mixed *miombo*, marsh, swamp and *dambo* and narrow bands of riverine vegetation. Under National Parks and private subsidized protection and so is relatively safe from

encroachment and human impact on vegetation.

Kanona District: visited 20 November 1993.

Kundalila Falls Picnic Area. Along Kaombe River. *Miombo*, *dambo*, riverine, rainforest and kopje (rocky outcrop vegetation types. Extremely rich botanically with over 20 species of orchid (including two species of *Vanilla*) and narrow endemic *Myriothamnus* sp. Dry rocky areas combined with wetter vegetation types under mist from falls and extensive *miombo* woodland below the falls makes this area one of the richest areas in all of Zambia. Some human settlements encroaching on the upper falls area with damage to delicate vegetation among rocks. This area is worthy of national protection.

Chinsali District: visited 25 November 1993.

Shiwa Ng'andu on the Mansa River, Chusa Falls. Near privately run lodge. Rocky outcrops, thin soils, some *miombo* woodland and *Uapaca* woodland. Entire area heavily impacted by human activity; farming, tree cutting, food collecting, medicinal harvesting, fishing, etc... The entire area, the river, falls, and hot springs, has long been recognized and visited. Botanical diversity is threatened by invasive weeds and human activity. Some level of protection is needed.

Serenje District: 7 May 1994.

Escarpment south of Serenje. On Chisomo - Serenje Road between 10 and 40km from Chisomo village. Altitudinal gradient produces a variety of vegetation types including open *miombo* woodland on broken quartz soils at higher elevations through riverine vegetation near the Fukwe River. Low population density through out and only localized villages widely spaced from each other. Potentially a good area for increased conservation protection.

Kabwe Rural District: visited 31 January 1995.

Chisamba. Approximately 7km W of Great North Road on road to Wardy Farm. Near Wangwe River in hill *miombo* and floodplain vegetation. Good mix of vegetation types and botanical richness. Site under some pressure from commercial and local cattle herds. Possible site for some protection due to the uniqueness of flora contained there.

^{1.}The determination of suitability hinges not only on biophysical soil parameters and crops, but also on economic, social, and political considerations. Some problematic soils may, through the addition of soil amendments (lime, fertilizers, micro-nutrients, gypsum) and construction of physical structures (subsurface drainage, terracing) be made biophysically

"suitable." Herein the use of the term suitability is confined to Zambia's context, where transport is difficult, inputs expensive, and internal markets limited.

^{2.} Data from the National Accounts Statistical Bulletins extracted from Water Master Plan (Yachiyo Engineering 1995).

^{3.} Data from the National Accounts Statistical Bulletins extracted from Water Master Plan (Yachiyo Engineering 1995).

^{4.} The information cited by Queiroz (1997) was provided by Mr. H.G. Mudenda, Director, Department of Fisheries, Ministry of Agriculture, Food and Fisheries.

^{5.} Currently FINNIDA is supporting forest cover surveys for 3 districts within Central Province where they are involved in the development of provincial forestry action plans (PFAPs).